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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, MARCH 20, 1924 Number 12

Magic

GREAT is the magic of the name of Ford. At a time when Washington is rocking from Lafayette Square to the Congressional Library with the repercussions of an injudicious lease of a disappearing natural resource, the House of Representatives in its wisdom votes practically to give away to Henry Ford, his heirs and assigns forever, the rights in a continuing resource of infinitely more intrinsic value than a few million barrels of oil and of infinitely greater influence on the lives and business of the citizens of the South and of the country at large. This is mass hypnotism of a sort which only a professional alienist can understand.

More Mystery

WHAT is behind the Department of Justice suit against the contractors on Camp Meade is a mystery. Well over a year ago the war frauds section went into the whole business of cantonment construction and as a result brought suit against ten of the sixteen camp contractors and had indictments brought against seven of the men at the head of the war construction program. The history of these cases is well known to the readers of this journal. The indictments have been dismissed as frivolous; the suits have gone through various legal processes in the several courts where brought but the assumption is that they are dead, or at least sleeping until such time as the government is able to particularize its charges of waste and corruption to the satisfaction of the court—something it has not yet done. Why, then, another suit, of precisely the same nature, should be brought at the present time is beyond the comprehension of an ordinary engineer—or editor. One who reads the current Washington dispatches would think the Department of Justice had more serious business in hand.

Commerce Before Power

THAT President Coolidge is favorably inclined to the St. Lawrence waterway is indicated by the personnel of the commission he has just appointed to study and recommend action on the project. Secretary Hoover, the chairman, is of course unprejudiced and doubtless has been selected for his experience and judgment in large engineering and economic questions, but the rest of the board, with the possible exception of the member from New York City, is already predominantly in favor of the waterway being carried through. Indeed, the executive secretary appointed by the President has been for years the driving force behind the Lakes-to-the-Ocean movement. It may be noted, too, that outside of Mr. Hoover, there is no one on the board who knows very much about water power or the industrial needs of the East. Indeed, the North and Central West, which for so many years has been clamoring for the ocean outlet may well be heartened by this expression of sympathy with its ambitions. It will take the best efforts of the engineering advisors of the international board to make clear to the public of both nations—and to the governments, too—that the problem of St. Lawrence is as much a power problem—perhaps more a power problem than it is a commercial or navigation problem.

A Neglected Opportunity

A STRANGE failure to utilize an opportunity for doing a real service to the railway engineer was evidenced in the report just presented by the A. R. E. A. committee on Signaling and Interlocking. It had been suggested to the committee that for the benefit of engineers not directly connected with signaling, it should prepare a summary of progress being made with automatic train control. But the report stated simply that: "It is impractical to issue a report on train control which will be of value to our members, as such a report would be out of date before issued." Then, illogically, the committee refers those who may be interested to information published from 1919 to 1921 by the signal section of the American Railway Association, such material being much more out of date than the 1924 report which might readily have been prepared by the committee. In view of the rapid development of the automatic train-control system and its approaching extensive introduction under the orders of the Interstate Commerce Commission, the system is of immediate interest to railway engineers, to many of whom it will be an additional factor in maintenance-of-way operations. If the committee seizes the opportunity still open and now does its work promptly and well, perhaps not much time will have been lost.

Road Maintenance Expenditures

EXPENDITURES for highway maintenance are reaching huge proportions. Some of the older eastern states already spend more annually for up-keep of old roads than they do for building new roads. Throughout the country the practice is the reverse. The vast majority of states have only begun the construction of the improved roads which traffic requires. Their construction account looms large not only in actual figures but in the concern and consideration of the people. These facts have served to overshadow in public thought the growing magnitude of the public-road-maintenance business. It is growing up unobserved. Excluding interest on funded debts for road construction, about 40 per cent of the present expenditures for highways is for maintenance. This percentage is based on the latest complete records of 1922. They are worth noting. According to the Bureau of Public Roads the highway expenditures for 1922 were $617,000,000 for construction and $245,000,000 for maintenance. About 30 per cent of all maintenance expenditures are for the 220,000 miles of state-system highways, which are less than 8 per cent of the total

mileage of all highways. The point to be given attention, however, does not lie in refinement of analysis, which the general figures available do not justify, but is the magnitude of the total maintenance expenditure. This puts highway up-keep among big business operations. It needs remembering too that it is a continuing business and a growing business and the part of the highway business most in danger of coming under political direction unless the situation is made clearly known to the road-using public.

With a Bow to the French Engineer

WHETHER it is because European engineers got a ten-year start on the Americans in this field or whether it is merely a part of the designing technique of a land where labor is cheap and material high, the French are infinitely bolder in the use of reinforced concrete than are the engineers in this country. The longest span concrete arch near Rouen, described in this issue, is a fair example. Let any American engineer consider a moment what would happen if he were to submit such a design to a board of consulting engineers—a span of 432 ft. carried on two arch ribs averaging 7 ft. square and, except near the abutments, of hollow box section with walls from 12 to 24 in. thick. Unfortunately bridge designing of this type is more or less a business secret in France, so the full details of the bridge are not forthcoming; indeed, we were told the other day by an engineer who had worked in the Limousin office that only the designers of this particular bridge were permitted to see the drawings or computations, which were kept locked up from other employees in a private safe. So we do not know what stresses were permitted, or what loads assumed, except as it is noted that the finished bridge deflected only slightly under a moving load quite comparable to the heavy design loads of this country. The thing that is of interest to American engineers is that in France, where certainly they do not have better concrete material than here and where if anything the highest grade of concreting practice is not so well developed as here—whatever may be said of the average practice—they can build and use safely a bridge whose design would cause any bridge engineer in this country to lie awake nights for the rest of his worry-shortened life.

Winter Costs Wanted

ACCEPTANCE of the doctrine of a lengthened construction season is advancing much faster than is knowledge of winter work practices and costs. In this situation there is a danger which was very properly referred to by the committee on methods of the Associated General Contractors in its report to the Chicago convention in January. Winter operations and work in wet weather are widely possible, but they require procedures and equipment peculiar to their characteristics and the contractor who rushes unprepared into cold weather construction invites trouble. There is enough experience now, particularly in winter building, to give a fair knowledge of winter practice and some knowledge of cold or wet weather costs, and movements in several directions are ostensibly under way to amass and analyze these data. The fundamental task, however, is not that of the Department of Commerce or of any bureau or association but belongs to the individual contractor; it is to keep costs of his winter work so that the items added by frost and rain conditions are segregated from the other items and from general costs. We must not forget that, despite recorded economies in other directions, it costs more to mix and place concrete in winter and to do other things affected by cold and wet weather, and we need to know this extra cost. The individual contractor is the only one who can give this information and then only when he has his cost items properly segregated to determine it.

Pavement Maintenance Guarantees

PAVEMENT maintenance guarantees continue to be required in the great majority of American cities. Of 77 cities exceeding 80,000 population which answered a questionnaire recently sent out by the Board of Local Improvements of Chicago all but eleven require a maintenance guarantee and of these eleven six cities do their own paving. In the majority of the cities the guarantee term is five years and from this period it ranges downward to one year. One city requires a guarantee for only six months and in one the term is ten years. Probably these figures will astonish no one who is reasonably acquainted with city paving contract practice. There is more of interest in the reports from the five cities which contract their paving and do not require maintenance guarantees and in the remarks on the practice which the engineers of several other cities offer. The opinion may be summarized as (1) use rigid inspection and careful engineering and it is cheaper for the city to do its own maintenance and (2) guarantees are unsatisfactory because court action is often necessary to enforce the obligation or the sureties fail. These are substantially the convictions which state highway departments have arrived at and none requires a guarantee. Indeed the tendency is constantly to hasten the time when sections of completed pavement on work in progress is taken over for the public and the contractor is relieved of further responsibility.

Stresses in Dams

FROM the additional information on the failure of the Gleno dam in Upper Italy, given in this issue on the authority of a careful Swiss observer, it appears with convincing finality that bad work was the sole cause of the disaster and that there is no mystery or technical uncertainty at the root of it. The foundation defied every principle of good practice and common sense. The stone masonry base was improperly built. The concrete of the cellular portion of the dam was defective both in materials and proportioning and in its placing. It is not unlikely that there were corresponding shortcomings in the distribution of steel in the concrete, but these were at best only accessory to the major fault of bad work. In the face of all these conditions, however, the calculations of shearing stresses contained in the present report do not appear to give a sufficient explanation of the failure.

Would the dam have broken to pieces so catastrophically if the same concrete superstructure had rested on a thoroughly strong and unyielding foundation? Cellular dam structures are inherently safe, and involve conservative stresses; their very nature eliminates the overturning moment of the gravity dam and therefore does away with its possible tensions and its concentrated toe pressure. Compression is so far the major stress in the cellular dam, when properly designed,

that tensions and shears remain insignificant even under such abnormal circumstances as prevailed in the Gleno case. But a slight yielding or settlement of the foundation introduces wholly new and alarming stress possibilities. The superstructure is too stiff to accommodate itself easily to such movements, and is likely to be strained in ways hardly capable of advance determination. Only a large surplus of strength can safeguard a dam against such strains. When the design and workmanship are of normal quality this large surplus of strength is realized, as we know from the several cases in which cellular dams resting on earth or gravel bottoms have survived a washout under the foundations. On the other hand such construction as was represented in the Gleno dam would make distortion stresses immediately threatening.

Thus, taking the bad foundation and base into account, it is possible to understand how the dam was able to support its full head of water for a month, and then, under unnoticed slight settlement and slip of the base, suddenly break to pieces and go down the valley.

Too Much Attempted

AT RECENT American Railway Engineering Association conventions the general complaint has been that there is so much material to be handled that little of it gets the attention it deserves. Everyone voices it yet no group makes any concerted effort to reduce the amount of work outlined.

Almost every year some new committee is appointed to deal with some new problem, and yet this year when one committee, after making a comprehensive report on improving relations with labor, had the temerity to suggest that that particular subject could well be dropped for a year or two in order to watch the development of some of the plans now being tried out, there was an outburst of objections to the effect that the field was new and the committee should continue its studies. It is true that this particular field is comparatively new and there is much more to be learned in it but little will be gained by taking up more of the time of the members of the committee in the next two years in merely extending their studies over minor details or to systems of dealing with employees similar to the ones they have already reviewed. They might well, as they suggest, turn their attention to other pressing problems for a few years and then come back to this subject after the test of time has been applied to the systems outlined in their report.

Much effort is being wasted in other ways. The committee on buildings feels that its section of the manual would not be complete without something on concrete and so overlaps the field of the committee on Masonry, which itself repeats old truths with solemn mien, the committee on track overlaps the field of the committee on Rail, and the committee on Rules and Organization overlaps the field of nearly every other committee in an effort to make the Instructions to Maintenance of Way Employees complete, writing into them many things that are specifications rather than rules of practice.

These derelictions are all faults common to many societies; they arise from a desire to do too much combined with the difficulties of maintaining an organization with non-interfering parts whose principal members must necessarily treat the work as subsidiary to their daily jobs. The growing complication of the A. R. E. A. goes deeper than this; its principal difficulty is that it attempts too much independent work, that it follows too closely the traditional view of railroading as a unique form of human endeavor which can learn nothing from allied activities. The A. R. E. A. committee must do everything for itself; it cannot accept the decisions of any other group, however expert, because the railroad man has come to believe both that his problems are different from other folks and that only his own craft or guild can solve them.

Time wasting reports by the dozen might be noted; subjects on which railroad engineers have no very expert knowledge. Why not let the real experts answer these questions in their own reports and specifications? Why should the A. R. E. A. get out "Specifications for adhesive and rubber tapes." When the larger questions of electric traction are of such importance to the railroads the committee on Electricity which wrote the tape specifications should not be wasting its time writing specifications for materials that electrical engineers must surely have perfected by this time.

At the latest convention, to be fair, there were some conspicuous examples of just the opposite condition. Two or three committees went to great lengths to see that everything went into their report, wherever it might conflict with the work of some other committee, was written by that committee or at least conformed with its requirements. They even went outside of the association in order to see that there should be no conflict in their specifications for materials or methods over which they were substantially in agreement with the other authorities or in matters which were more especially the field of such outside organizations. The reports of these committees are splendid examples of what can be gained by co-operation between the major engineering societies.

But these are the exceptions. If the American Railway Engineering Association is to continue to be of real value to the railways there must be a considerable reduction in the amount of material presented to its conventions for action and in the number of subjects given to individual committees for their consideration. No one of the standing committees can do much in this respect other than in co-operating with other committees where it is obvious that their work is going to overlap. Good work was done by the committee on Iron and Steel Structures in witholding the specifications for steel highway bridges from publication in the manual until after the joint committee of the A. R. E. A., the Am. Soc. C. E. and the State Highway Officials had made their report on a uniform set of specifications for such structures.

But what is most needed is a general elimination of subjects from the A. R. E. A. program; a matter for action by the board of directors. Chief among the subjects which could well be eliminated are specifications for material. Outside of rail specifications the A. R. E. A. might well write into its manual specifications for paint, cement, creosote oil, tool steel, and many other materials prepared by such organizations as the American Societies of Civil Engineers and for Testing Materials. There is no important difference between such specifications and those prepared by the A. R. E. A. committees and there is no reason why the time of the association or of its committees should be taken up in the preparation or revision of such specifications at the expense of the more important railway problems.

Concrete Bridge with Longest Arch Completed in France

Clear Span of 432.44 Ft. Provided in Structure Bridging Seine River Near Rouen—Twin Ribs of Large Section Are Hollow—Precast Floorbeams Hung From Arch by Concrete-Encased Steel Hangers

THERE has recently been completed in northern France a reinforced-concrete bridge of unusual design which contains the longest concrete arch yet constructed—131.8 m. (432.44 ft.). It spans the Seine between the towns of St. Pierre-du-Vauvray and Andé (about 16 miles from Rouen) and replaces an old iron bridge which was badly damaged by passing vessels during high floods. The arch is composed of two hollow ribs of large section to which concrete-encased steel bands, supporting the floor system, are hung. Only at two places—the arch ends—are the ribs tied together. The rise from springing to the arch crown is 25 m. and elliptical in shape in order to lessen the lateral thrust on the foundations.

The floor system has a total width of 8.80 m. (28.87 ft.) of which 8 m. is of usable width. It carries a roadway 5.35 m. in width and two sidewalks of 1.345 m. each. The floor system is carried on reinforced-concrete lattice girders spaced on 5.24-m. centers, suspended from the arch ribs by hangers made of steel bands encased in concrete. Each hanger is built up of 40 strands of steel cable, each 10 mm. in diameter. The hangers are then treated with a rich mixture of cement in such a manner as to form a band of rein-

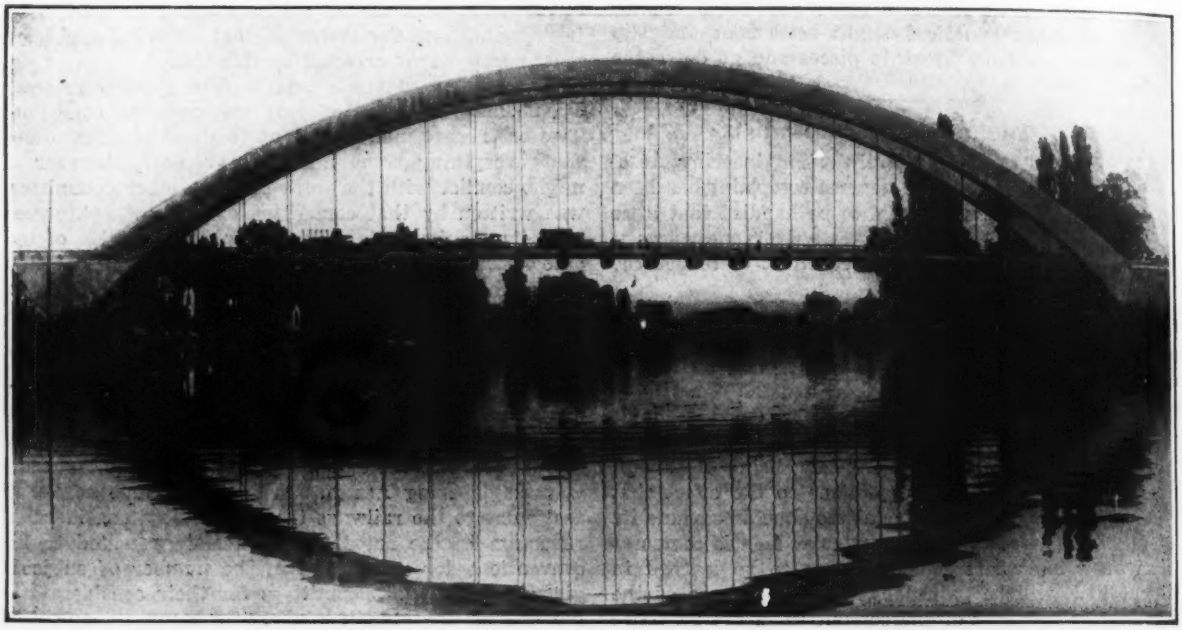


FIG. 1—COMPLETED LONGEST REINFORCED-CONCRETE ARCH, ACROSS SEINE RIVER NEAR ROUEN

the distance between the axes of the two ribs is 8.9 m. The exterior width of each arch is 2.5 m. (7.2 ft.) throughout and the depth varies from 4.1 m. (13.45 ft.) at the springing to 2.5 m. at the crown. Through the greater part of the ribs these thicknesses are enlarged only between 0.36 and 0.33 m., being reinforced only near the springing.

Construction Details—The thickness of the walls of the arch varies as to rectangular cross-section from 0.6 m. (1.97 ft.) at the springing to 0.33 m. (1.08 ft.) at the crown; although throughout the greater part of the arch the thicknesses are limited between 0.36 and 0.33 m., being widened only as the arch ribs approach the springing. Below the sidewalk level the arch ribs are solid and integral with the abutments. The thickness of the vertical walls of the ribs is 0.2 m. (0.66 ft.) throughout almost their entire length except toward the base where this thickness is increased to 0.3 m. (0.98 ft.)

The form of the arch rib section gives to it a high moment of inertia and rigidity without at the same time increasing the weight. The arches were made

forced concrete 0.14 x 0.14 m. (0.46 ft.) in section. Actually, this band acts only as a purely metallic suspender having the total effective section of the 40 bars of steel of 10-mm. section, the concrete serving only as a protection for the metal against disintegration.

The upper end of each hanger passes through the lower wall of the arch rib and into a compartment built integrally with the arch rib. These compartments, which serve as fastening for the vertical hangers, and also as reinforcement for the rib itself, were so constructed that, after the hangers were threaded through the holes in the bottom walls of the arch ribs, the ends were broomed to fit a triangular opening. When the ends of the bars forming the hangers were spread apart the interstices were filled with cement mortar. Thus each hanger was afforded practically the same anchorage as would be found at the cable ends of a suspension bridge. The walls of each of these hanger chambers are strongly reinforced. The peculiar construction makes it possible for the arch rib through the suspenders to carry the floor loading uniformly. Above each one of these hanger compartments is a manhole so

that ingress is provided for interior inspection of the entire arch rib.

At their lower ends, the hangers are again spread apart and curved in the form of stirrups after they are threaded through holes cast in the ends of the latticed floorbeams. After the suspenders are threaded through the beams, the hole is filled with a rich cement. The precast latticed floorbeams have a maximum depth of 1.5 m. (4.92 ft.) and a thickness of 0.2 m. (0.66 ft.).

The foundations of the bridge were carried down to bed rock, which was found at about El. —4. The foundation work was a compressed-air job. Clay was first encountered, then a bed of gravel and sand, the foundations finally resting on a bank of chalk about 13 m. below the low-water mark.

Above the floor level and throughout their entire development the arch ribs are joined only by the two cross-ties which are so placed that there is a clearance above the roadway level of at least 5 m. (16.40 ft.). These cross-ties are hollow, their walls being very thin, only 0.08 m. (0.26 ft.) in thickness save through the wall corresponding to the intrados which has a thickness of 0.1 m. (0.33 ft.). In the middle of the side walls of the cross-ties are placed frames of reinforcement of a height of 0.5 m. and thickness of 0.1 m. The very large section given the arch ribs and the stability which results from such a large section have permitted the limiting of cross-connection between arch ribs to these two points, a fact which contributes to the slender appearance of the bridge itself.

Construction of Arch Centering—In construction it was necessary that the least possible amount of interference to navigation be given. In consequence, the fewest possible points of support were selected in the river bed for the arch centering—two groups of dolphins in the river bed itself and two other groups near each bank of the river. Each group of supports is composed of four dolphins, two in the middle to support the centering and two at either side in order to serve as protection. Each dolphin is composed of four piles. For one set of supports the old abutment of the metallic bridge served as foundation. The arch centering itself is supported on these dolphins by sets of shear legs. More than a year previous to actual construction of the bridge, all framework was blown down during a heavy wind storm. However, no departure from original design resulted.

In the construction of the centering, as well as in that of the supports, the usual method of making all connections with bolts was discarded in favor of nailed connections. The sections of centering were constructed only after precise determinations had been made of the loads to be imposed. This system allowed greater rigidity than would have obtained by the employment of pin connections. In this latter system, in fact, bolt holes become enlarged so that with the contraction and expansion of the wooden members deformation of the pieces is often quite considerable.

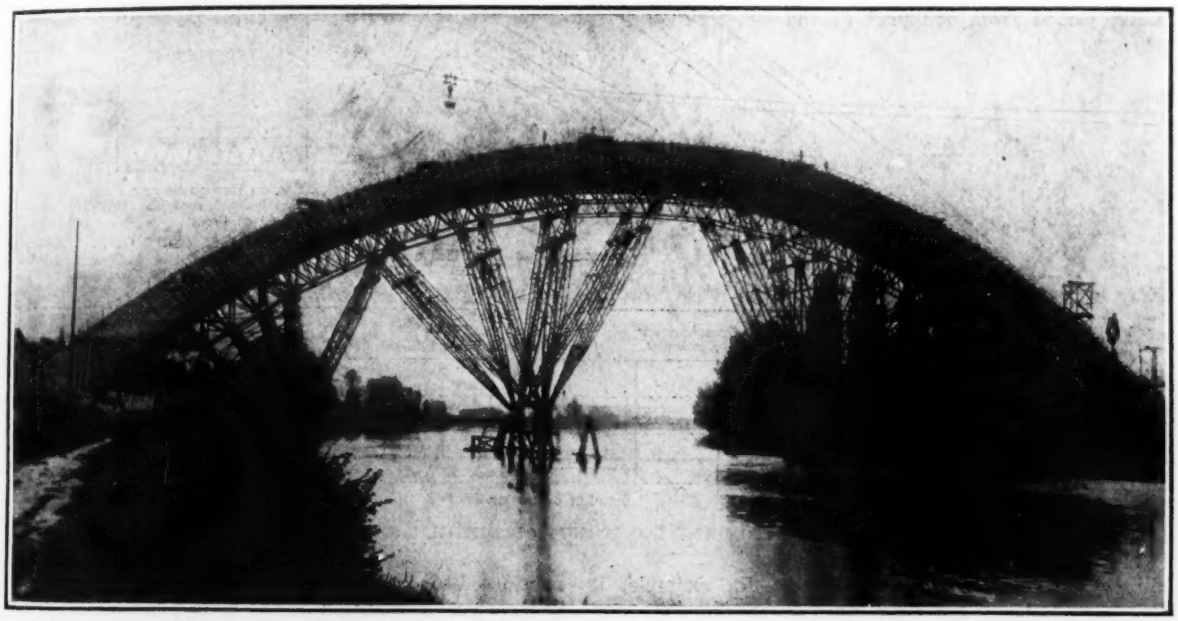


FIG. 2—SHEAR LEGS ON PILE DOLPHINS SUPPORT CENTERING AND RIB FORMWORK

The truss members supporting the arch centering were assembled and then put in place by means of a cableway installed across the river along the axis of the bridge. Installation of this cableway was the first construction process. This carrier, 170 m. (557.77 ft.) long, was constituted of double cable stretched between two guyed towers.

Each one of the dolphins set in the bed of the river carried four shear legs and each of the two placed near the banks of the river supported three. The outside shear legs of the two bank dolphins and the two outside ones at the center dolphins supported the arch at the same point. Thus there were provided a dozen points of support almost equally spaced along the intrados of the arch. The centering itself was built up of triangular trussed pieces formed also of nailed timber. Each unit of the centering constituted a triangular isostatic system, a single connection being introduced by the junction of the two halves of the centering at the arch crown. Formwork for the arches was constructed also

in elementary panels on the banks of the river and carried to place by the aid of the aerial cableway.

Concreting Phases—The concrete mixed in mechanical mixers was placed by skips carried on the aerial cableway. Concreting was executed in four phases. The first phase consisted in pouring the entire length of the lower face of the arch ribs, and the second phase in pouring the side walls up to half of their height. The third phase consisted in bringing the side walls to their full height, and the fourth in pouring the top faces of the arch ribs. The centering was also loaded progressively and thus there were avoided any eccentric or excessive local loadings which would have followed were construction of the arch ribs carried out section by section.

The reinforcement of the arch ribs was relatively unimportant. It was composed of round steel bars of small diameter distributed uniformly in the faces of the arch ribs and in the side walls. The total section of metal varied from one part of the rib to the other. Toward the key, for example, it was composed of ten bars of 14-mm. diameter and ten of 7-mm. diameter for each of the two horizontal faces, and eleven bars 7 mm. in diameter for each of the side walls.

The concrete contained 350 kg. (770 lb.) of cement per cubic meter of the whole mixture. It was mixed wet enough to reach easily all parts of the formwork in spite of the thinness of some of the walls of the arch ribs. In order to assure, however, that the concrete would completely fill all interstices compressed-air vibrators were used on the outside of the forms during pouring.

Removal of Centering—The arch centering was removed by use of a process designed by M. Freyssinet, a method he had already put to use in the construction of the bridge at Villeneuve-sur-Lot. This method consisted not in lowering the centering under the arch, but in raising the arch away from the shores. In order to do that, each arch rib was poured in two sections. The two sections were separated at the crown by a narrow space into which were placed hydraulic jacks acting horizontally and powerful enough to take the thrust of the arch ribs when the centering would be removed. When the jacks were put into play, the two semi-arch ribs were pried apart and the arch centering taken away. Into this interval there was then placed a key of concrete brushed with fresh cement and strongly reinforced. These concrete blocks therefore served as keystones to the arch ribs.

After the arch centering was taken down construction of the rib cross-ties and of the floor system was carried forward. The floor system was constituted of reinforced-concrete slab taking support on the trussed floorbeams. Expansion joints were provided at either end of the bridge. At these two points the entire floor system was cut through, two floorbeams being hung from the arch ribs at expansion joints.

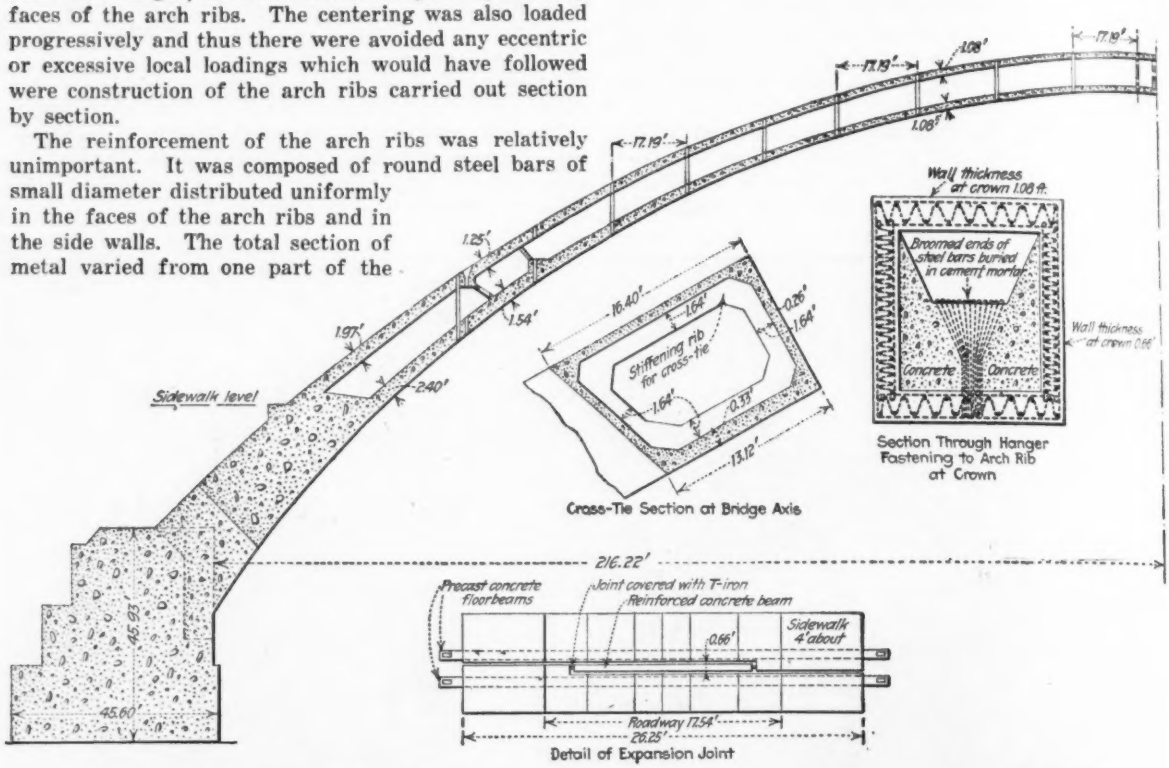


FIG. 3—HALF-SECTION OF ARCH RIB AND CONSTRUCTION DETAILS, ST. PIERRE DU VAUVRAY BRIDGE

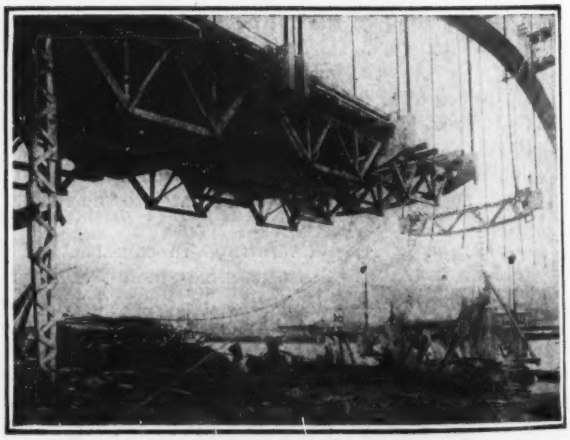


FIG. 4—HANGING PRECAST FLOORBEAMS

Test live-loads were placed on the bridge, tests including both stationary and moving loads. Under the former loading (880 lb. per square meter) the maximum deflection was 12 mm. for the arch and 14 mm. for the floor.

The moving test load consisted in the simultaneous passage of a string of vehicles on the upstream side composed of two trucks of 7 tons drawing trailers of 7 and 12 tons, and of a downstream file of vehicles composed of two trucks of 7 tons followed by a steam roller of 16 tons and a truck of 8 tons, the sidewalks being at the same time loaded uniformly with a load of 400 kg. per square meter. Under this total load the maximum deflection was 2 mm. only for the arch ribs and 7 mm. for the floor system.

The construction of the bridge was under the direction of the Limousin Co. and was designed by M. Freyssinet, under the direction of M. Perrier, engineer-in-chief of Ponts et Chausseés, and by MM. Hupner and Genthial, engineers of Ponts et Chausseés.

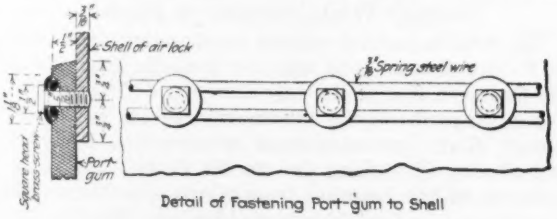
Most of the material from which this article was written was taken from a recent issue of *Le Genie Civil.*

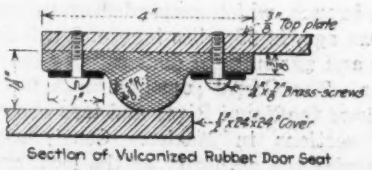
Foundation Cylinders Concreted by Pneumatic Method

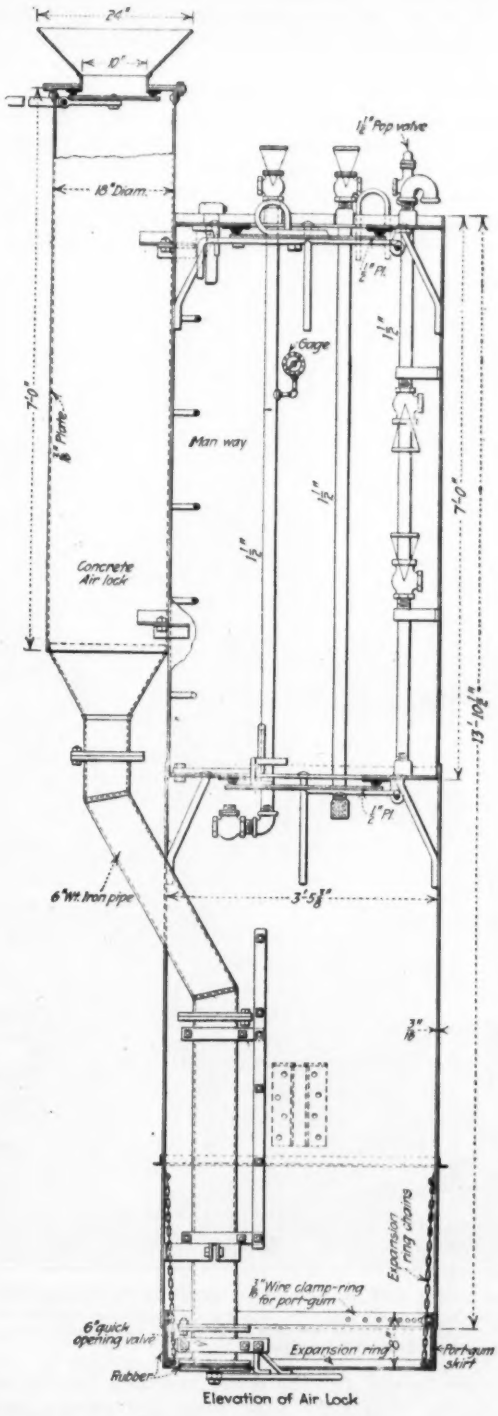
Combination Concrete Lock and Manway Inserted in Top of Concrete Cylinder and Made Tight with Rubber Skirt

By W. F. Way
Structural Engineer with Henry & McFee, Seattle

During the construction of pier No. 5 and extending through the building of pier No. 4 in the U. S. Navy Yard at Bremerton, Wash., described in *Engineering News-Record,* March 13, 1924, p. 436, an air-lock method was used for unwatering the precast concrete cylinders, cleaning out the mud and pouring the concrete. This method was developed after it had been demonstrated that the cylinders could not be sealed in a suitable manner with tremie concrete as originally planned. The character and depth of the mud, the numerous piles at the lower end of the cylinder and the small amount of tremie concrete specified (3 ft. deep) were all factors combining to make the method unsatisfactory. The air locks were used successfully for both piers 5 and 4, 226 cylinders being filled by this method.







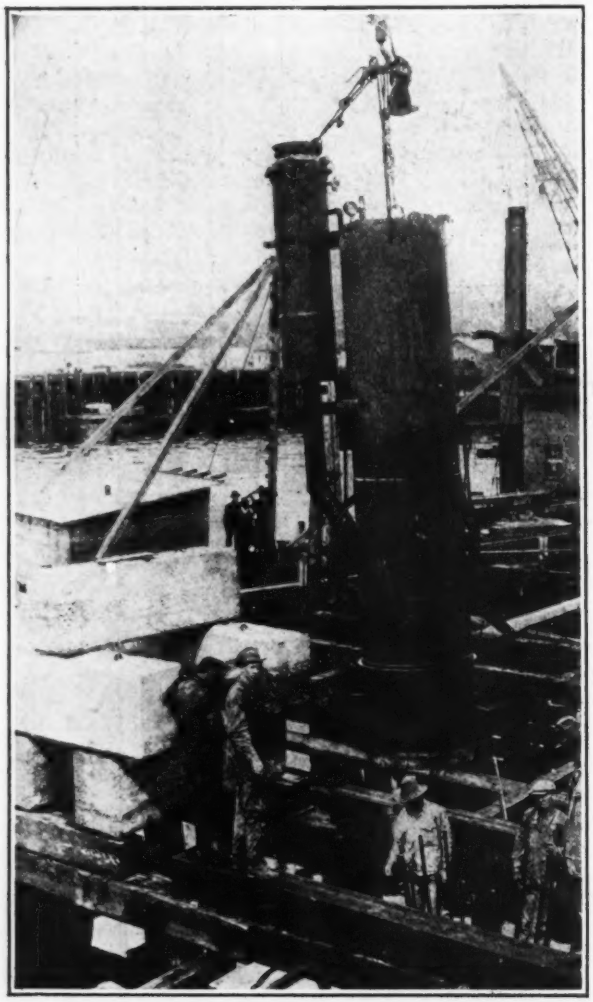
ELEVATION AND DETAILS OF AIR LOCK

The locks were made of ⅜-in. plate, were 14 ft. long and had a diameter less than the inside diameter of the cylinder by working clearance. The lock was inserted 2 ft. into the top of the cylinder and was fastened down on pier No. 5 cylinders by clamping to the extended main reinforcement. On pier No. 4 stirrups were cast in the top of the cylinder shells to which the connection was made.

The airtight connection between the air lock and the

inside of the concrete cylinder was made by a "port gum" skirt, ½ in. thick and 8 in. wide, vulcanized into a circle and fastened to the inside of the lock at the bottom as shown in the accompanying illustration; an expanding metal ring was used to press this skirt against the concrete surface so as to close the joint sufficiently to enable the pressure to build up; as the pressures increased the seal automatically became tight.

After experiment with pieces of rubber cut from stock material failed to give the desired results, special gas-



AIR LOCK GOING DOWN TO CONCRETE CYLINDER
Reinforcing bars from the top of the cylinder appear in foreground. Concrete weights at left used to balance buoyant effect of air-filled cylinder.

kets were molded for the doors and also for the concrete valve. The locks were wired for electric lights and telephone, although the latter did not prove to be very satisfactory and it was found better to rely on signals.

After a cylinder had been set and braced and the temporary concrete rack placed on top of the cylinder, the air lock was lifted from the last finished cylinder and lowered into place. Following this the connection between the lock and cylinder was made and then the 3-ton concrete counterweights to balance the air uplift were set on the rack. It was necessary to do this work at low tide in order that a workman could go inside and tighten the expanding band to seal the lock chamber, after which the middle door was closed and air admitted.

The air pressure in the concrete cylinder was increased gradually so as to allow the water sufficient time to escape. This was necessary because the uplift, when the cylinder was full of water, and full pressure on, exceeded the total weight available to balance it.

The water flowing out under the bell end of the cylinder carried most of the loose mud with it. When the cylinder was unwatered two workmen entered through the lock and descended to the bottom where they cleaned out the remaining mud and washed down the inside of the bell with a water hose.

All the material in the off-shore cylinders was loose mud practically free from sand and gravel and was easily ejected by washing, using a sump at the edge of the concrete shell where the escaping air carried it out. In the inshore cylinders where foundation piles were not used, hard cemented gravel was encountered which had to be broken up with a pick and shoveled into the sump. The bell sections were not provided with cutting edges, and this retarded the work somewhat.

After the inside of the cylinder was cleaned out the men came up to the top of the compressed-air chamber and concreting began; one man operated the concrete valve and the other occupied the top chamber of the lock, where he did the signaling by tapping on the shell. The concrete was allowed to drop free through the empty shell to the bottom after careful inspection had shown no separation of the aggregate.

Concrete was mixed on a floating mixer equipped with a derrick which delivered by means of a bucket to a hopper slung just over the lock. The concrete lock was charged from this hopper with ¼-cu.yd. batches. On pier 5 only two locks were used, but on the pier 4 extension three locks were necessary to keep up with the work.

Railway Work Increases in Mexico

The most important railway construction undertaken in Mexico during 1923 was the 100-mile extension of the Southern Pacific Railway Company of Mexico from Tepic, Nayarit, to La Quemada, Jalisco, which will permit direct communication between San Francisco and Mexico City along the Pacific Coast. The reconstruction of the branches from Navojoa to Alamos and from Corral to Tonichi was also begun. The Navojoa-Alamos branch, which suspended operations more than ten years ago, is 38 miles long and will link up a rich mining and agricultural district with the main line at Navojoa. The Corral-Tonichi branch is 96 miles long and follows the Yaqui River and taps one of the richest mining sections in Mexico. Construction was also begun under the authority of the local government on the National Railway of Lower California. A new contract was entered into by the Mexican government with the Pachuca-Tampico R.R. calling for the completion of the line by February, 1924, and for the completion of the Ixmiquilpan Branch by September, 1924. Pachuca and Ixmiquilpan are both in the State of Hidalgo and the new railroad will therefore traverse an already developed oil, agricultural, and industrial area. The extension will have an approximate length of 300 miles. Its importance lies in the fact that it will give Tampico a direct communication with Mexico City.

American Railway Engineering Association Meeting

Twenty-fifth Anniversary Marked by Record Attendance—Much Discussion Despite Mass of Reports Handled—More Co-operation Needed Between Committees to Prevent Duplication

ANALYTICAL studies of the facilities required for large passenger stations and of the economics of freight train service were outstanding subjects of special interest to the railway engineer and operating official respectively in the reports presented at the annual meeting of the American Railway Engineering Association, held in Chicago on March 11 to 13. A new feature was the first report of the committee on Co-operative Relations with Universities. Many of the reports contained interesting material, but largely of a more routine character or in the way of general information on a variety of subjects. Some of the committees received congratulations upon their work along the broader lines of investigation, but one committee was sharply criticised for its failure to report on an important subject specially suggested to it as of very present interest. With the increased number and variety of subjects covered by each committee the amount of material at these conventions has become so great that presentation of the reports occupies the greater part of the time, consequently in the following review of the proceedings there is comparatively little to record in constructive discussions.

Economics and Standards—A number of committees are now dealing with fundamental principles and economics rather than with details of practice. The relative merits of increasing train loads by reducing ruling grades or by introducing more powerful locomotives was the subject of a report by the committee on Economics of Railway Location, showing that the two methods are not necessarily alternatives but may supplement each other. In the same way, the committee on Economics of Railway Operation discussed methods of increasing traffic capacity and gave an elaborate analysis of the cost of stopping and accelerating freight trains; it also discussed more briefly the economies of running solid freight trains between terminals.

The establishment of units of measure in work performed on maintenance-of-way work was discussed by the two committees on Economics of Railway Labor, and Records and Accounts. A detailed analysis of the movement of passengers on station platforms, stairs and ramps was a notable feature of the report on Yards and Terminals, and the report on Wood Preservation included a voluminous report by the sub-committee on marine piling research. A study of the economics of bridge replacement (by filling or renewal) was included in the report of the committee on Roadway.

Standardization was a prominent subject at the 1923 meeting, but this year the committee's report simply listed the standards prepared by various committees during the year and noted the extended co-operation with the American Engineering Standards Committee. However, an important step was taken when Mr. Frink (Seaboard Air Line) showed that under a proposed revision of the constitution of the A.E.S.C. it is proposed to eliminate the power of veto now possessed by the sponsor of a specification. At his suggestion the following resolution was adopted: "The American Railway Engineering Association believes that it will be a serious mistake on the part of the American Engineering Standards Committee so to change its constitution and rules of procedure as to eliminate or even impair the veto power now possessed by the sponsor or sponsors of a project."

Stations and Buildings—Supplementing previous reports on the design of freight and passenger stations, the committee on Yards and Terminals presented a long analytical report on the arrangement and dimensions of the various facilities required at large passenger stations, together with graphic analysis of the speed of movement of passengers on platforms and exit stairways and ramps. The subcommittee on Scales reported that specifications for automatic indicating devices for weighing are impracticable as such devices are patented articles, but a certain tolerance as to accuracy of weighing should be required. The committee on Buildings asked and secured the adoption of specifications for railway buildings but its specification for masonry was objected to (and withdrawn) as conflicting with that of the committee on Masonry. In this discussion reference was made to the desirability of eliminating such overlap in the specifications of different committees, in the interest of uniformity. Information as to paints, painting, icing stations and different types of floors was accepted, except that the paragraphs on floors for freighthouses and enginehouses were referred back to the committee as being inadequate.

Rails and Joints—In its study of rail manufacturing practice the Rail committee has secured test data on 100,000 tons of high-silicon dead-setting steel from six mills. This record indicates a better quality than the average output under standard specifications and without additional rejections or hardship upon the manufacturers. Rail failure statistics indicate that the 1917 rails register the peak of bad performance and that the good record of 1914 rails will soon be equaled. A design for a 150-lb. rail 7⅞ in. high was submitted and adopted, as well as specifications for quenched carbon steel splice bars and quenched carbon and alloy steel bolts. The report included a series of comparative sections of rails of different types, prepared by W. C. Cushing.

The 3½-in. width of head in the 150-lb. rail being opposed as excessive, Mr. Cushing (Pennsylvania R.R.) pointed out that a wide support for the splice bar is necessary, as well as ample width of bearing for worn wheels and rails. Furthermore, substantially the same width of head is used on heavy rails of the New York Central R.R. and the Pennsylvania R.R. In a written discussion Mr. Gennet (Robert W. Hunt & Co.) disapproved of the movement to increase the carbon content of heavy rails, as being likely to decrease the ductility to such an extent as to lead to increase of failures, especially those due to fissures. He advocated extensive trials of rails of radically different composition from those now manufactured, for the reason that "the present standard composition of open-hearth rail steel was arrived at very much by the rule of thumb."

The Rail committee is still considering the study of the length of rails; the 60-ft. length was abandoned on account of expansion troubles, and there was such

a division of opinion concerning 45 ft. and 39 ft. that the committee is not yet prepared to recommend any length greater than the present 33-ft. standard. No conclusions have been arrived at regarding transverse fissures or the canting of rails, which latter subject is also under consideration by the committees on Track and on Stresses in Railroad Track.

As to the curving of rails, the committee on Track reported a variety of practice but recommended that rails need not be curved except for curves very much sharper than those usually found on main track. This was adopted after some discussion which reflected the wide difference of opinion noted in the report. Rerolling old rails for renewals is not economical at the present high cost of this work, according to the same committee, but the resawing of rails to remove battered ends is on the increase. A progress report showed the types of girder rails available for track construction in and across streets and roads.

Track Material and Maintenance—With increased weight of locomotive and cars there is widespread trouble due to deformation of roadbed which was formerly stable, with resultant irregularity in track, strains in track and greater work of maintenance. This opinion is the result of an investigation by the committee on Roadway. This committee also discussed the question of relatively high cost of track maintenance in the first few years after construction. The committee on Ballast noted a growing sentiment in favor of a smaller maximum size than the standard 2½ in. for hard rock and a smaller size than the standard where the track carries extremely heavy freight traffic. It concludes also that a concrete slab foundation for ballast is too expensive for use except under unusual conditions of very soft roadbed.

A general increase in size of tie from the earlier 6x8 in. x 8 ft. was noted by the committee on Ties, which recommended 7x9 in. with a length of 8½ or 9 ft. and a minimum clear spacing of 10 in. There was some objection to this spacing until the committee made it clear that this is a minimum spacing, sufficient to allow proper tamping. According to the committee on Wood Preservation, only treated ties should be used in permanent tracks, with the exception of a few durable woods. Varying lengths of life may be expected from various types of treatment, and the choice of treatment should be considered as a problem of risk in investment as shown by the probable annual charge. Approximate life may be given as 16 to 25 years (varying with maintenance condition) for the empty-cell creosote process; 8 to 18 for zinc-creosote and 6 to 15 for zinc. Full-cell creosoting is not warranted, because under present conditions the limit of life by mechanical wear will be much shorter than that from decay.

Information as to the value of machine adzing and boring of treated ties in relation to their life was asked for by Hunter McDonald (N., C. & St. L. R.R.) but the reply from the committee was that these processes have been used for too short a time to enable figures to be given, although there are evident advantages, such as better treatment by reason of the spike holes. Mr. McDonald also suggested that for every treated tie removed the exact reason for removal should be put on record.

Detail plans of switches, frogs and track crossings, submitted by the committee on Track were adopted; also specifications for track tools. The reduction of styles of woven-wire fencing from 262 to 69 was noted by the committee on Signs, Fences and Crossings. From a study of fence posts the average life was presented as 50 years for concrete, 22½ for steel and 23 for wood.

The track committee was asked to report upon a special track level for use on curves to determine the superelevation of the outer rail at one reading.

Bridges and Trestles—A classification of railway bridges according to the loads which they can safely carry for a limited time was presented by the committee on Iron and Steel Structures and was adopted. Its specifications for turntables were also adopted, practically without discussion, but it withdrew its specifications for steel highway bridges in order to confer with representatives of other associations which are preparing similar specifications. Electric welding of structures was said to have made insufficient progress for any action to be recommended. Other subjects under investigation by this committee include the strength of I-beams connected in groups by diaphragms and bracing, the relative merits of punched work and reamed work, and a formula for bearing pressures on large rollers, such as the segmental heels of rolling-lift bridges. The committee on Roadway withdrew its recommended practice as to the calculation of economies of bridge filling and renewal, since the discussion showed that the matter was not presented with sufficient clearness.

That ballasted deck trestles have many advantages over the open-deck type and should be built of treated material is the opinion of the committee on Wooden Bridges and Trestles, but further investigation is to be made. This brief report referred also to the grading of structural timber, now under consideration by a joint committee representing this Association, the Association of Testing Materials and the Central Committee on Lumber Standards. This joint committee has recommended a separation of structural timber into two classes: (1) Structural timber, 6x6-in. and larger; (2) heavy building material, which would be classified as yard lumber.

A protracted discussion on the feasibility of determining live- and dead-loads on concrete structures under earth fills followed a report of the committee on Masonry in regard to the design of such structures. The committee has tentatively adopted an impact formula for such cases, in which the dead-load is a determining factor. The general opinion was that information now available is entirely inadequate for such formulas. Prof. Talbot pointed out the uncertain conditions of a fill, due to possible arch action, tests having shown that actual pressures may exceed the computed load owing to the way in which the material was placed or had settled. Mr. Frink considered that for structures of this class the design must be adapted to maximum considerations and not carried to too great a refinement for saving of material on the basis of theoretical analysis of assumed conditions.

Regulations and Records—Revised instructions for the guidance of engineering field parties, to replace the rules now in the Manual, were adopted, as submitted by the committee on Rules and Organization. But a proposed extensive set of rules for employees of the maintenance-of-way department met with

many objections. It was pointed out that in some cases the material belongs in specifications rather than in "rules" or matter for the guidance of section foremen, while definite statements should not be made concerning subjects still under discussion by the Association. These rules were referred back to the committee for further consideration and for co-operative study with other committees in order to eliminate the "specification rules." Mr. Ford (Rock Island Lines) pointed out the tendency of committees to present conflicting material and he suggested that the committee on Outline of Work should act as a clearing house in order to avoid this situation.

Cost keeping methods and statistical records for ascertaining unit costs of individual items of engineering and maintenance-of-way work were submitted as information in a progress report of the committee on Records and Accounts. A separate report of this committee reported its work in relation to the proposed revision of the classification of accounts by the Interstate Commerce Commission. For this purpose a subcommittee was appointed to work with a committee of the Railway Accounting Officers' Association. This latter committee has reported against the proposed revision of the classification of operating expenses and is now considering the revised classification of investment in road and equipment.

On motion of Mr. Morse (C., R. I. & P. Ry.) a resolution was adopted expressing concern at the proposed revision of operating accounts and pointing out that as economy in maintenance work is dependent upon detailed accounting to provide cost records, uniformity in such records is essential to permit the Interstate Commerce Commission to properly apply the requirements of the Transportation Act.

Water and Fuel Supply—Protection and treatment of drinking water furnished to railway passengers, under the regulations of the Government Health Service were outlined in the report of the committee on Water Service, which pointed out that the Standard Sanitary Railway Code is now used by thirty-two states and adopted by the American Railway Association for the sake of securing uniformity in regulations. Complaints as to injurious effects of drinking water from lime and soda-ash treating plants are apparently without foundation, but this position was disputed during discussion. Standard methods of water analysis were submitted for the Manual and adopted. Lead and substitute joints for cast-iron pipe were discussed. The report also discussed the economic aspects of the use of treated water for locomotives, showing a larger saving in cost for boiler repairs and in delays due to boiler troubles. Conclusions as to the advantages of creosoted lumber for tanks were adopted.

Recommendations as to the storage and distribution of fuel oil, presented by the committee on Shops and Locomotive Terminals were withdrawn after a discussion which indicated that some engineers on roads using oil fuel extensively do not consider these conclusions adequate. In particular the fire protection methods and the discharging of oil from tank cars into receptacles between the rails were disapproved. The latter practice is general, but discharge into troughs leading to an underground conduit is considered preferable. The matter was accepted as information and the committee will make further study of the subject. Protection of oil stations from stray currents as a cause of fire was included in the report of the committee on Electricity.

Miscellaneous—The committee on Uniform General Contract Forms submitted forms of agreement for (A) trackage rights, (B) license for wires, pipes, hoppers and other structures on railway property; (C) joint use of passenger stations, and (D) placing snow or sand fences on private property. The committee also listed a number of cases of conflict between contract forms in the Manual and the specifications of other committees. By co-operation with the several committees it is hoped to remedy this condition during 1924. The committee on Electricity submitted specifications for the construction of overhead electric supply lines on railway property. Also a tabular record of clearances for third-rail and overhead wire conductors on a number of railroads. The committee on Signaling and Interlocking made a very brief report to the effect it was impracticable to make a useful report on automatic train control at this time, as had been requested. The convention thought otherwise and after some criticism the committee was instructed to undertake the task. Specifications for cold bituminous paving for road crossings were submitted by the committee on Signs, Fences and Crossings, together with a preliminary outline of the present situation in regard to grade separations of highway crossings.

Co-operation of Railways and Universities—The first report of this new committee outlined its purpose as laid down by the Board of Direction, which includes: (1) Interesting railway officers in assisting to develop the best possible technical courses; (2) bringing to the attention of the railroads the benefits of technical education, and (3) making the facilities of the universities more directly available for the research work of the Association. Much of the preliminary work of the committee has consisted in forming contact with various organizations, both to form a broad foundation for its work and to avoid duplication of effort.

Bavarian Studies on Use of City Refuse

Slightly condensed from an abstract in "Municipal Engineering and the Sanitary Record," Feb. 7, 1924, of an article by Jacob Bodler, Stadtbaurat in Munich, published in "Gesundheits-Ingenieur," Nov. 10, 1923.

A thorough examination of refuse from Munich (see *Zeitschrift des Bayerischen Revisionsvereins*, Nos. 7 and 8, 1921) showed that it would be economically wasteful to use for fuel fine refuse of low calorific value but rich in fertilizing material. By means of practical comparative manurial experiments made in the year 1922 with (1) fine refuse, (2) compost (a mixture of fine refuse and sludge), and (3) artificial manure, the Bavarian State Institute for the Growth and Protection of Plants showed that compost as well as fine refuse—both may be referred to as humus manure—are very suitable for manure and that, contrary to expectation, both these kinds of manures are only slightly inferior to artificial manure in their effect on stony and sandy soil, which is deficient in humus. The results of the experiments will shortly be published in *Praktische Blätter*, No. 6. The experiments show clearly that the most economic use of refuse where there is soil deficient in humus consists in using the sifted fine refuse for agricultural purposes and the remaining refuse as fuel. If the calorific value of such refuse remains below 4,000 B.t.u. per lb., in spite of the sifting process, it may be enriched with fuel debris. In towns with sewage-works, the fine refuse may, if expedient, be mixed with the settled or precipitated sewage sludge. By this means a humus manure is obtained which can easily be spread and is rich in plant-feeding material. It is even superior to fine refuse in its effects.

Illinois Tests Pavement Surfaces by Profilometer

Sixteen-wheel Carriage Hauled Over Pavement Inscribes Graph and Casts up Sum of Vertical Irregularities

By H. F. Clemmer
Engineer of Materials, Division of Highways, Springfield, Ill.

IN THE development of apparatus for the testing of pavements, the Illinois Division of Highways has recently added to its equipment an improved type of profilometer. This instrument, from the results of tests, has proved itself to be more accurate than the cumbersome and expensive method in which the straightedge is employed.

It was the original purpose of the department in designing the profilometer to construct an instrument that would compare the work of several types of finishing machines, obtain a value that would be an index of the smoothness and riding qualities of any pavement, and furnish a record that could be used in the investigation of such surface phenomena as waving and hair checking. It has been possible, however, due to the precise nature of the record obtained, to locate the "high spots" on a pavement surface with greater efficiency both in time and accuracy than can be done with the straight-edge. Illinois specifications for finished pavement surface require that all irregularities greater than ¼ in. in 10 ft. be chiseled or bushed to within the maximum allowable variation, and it has been the custom of the state department to locate and remove these irregularities, charging the contractor a nominal sum for this service.

Fig. 1 shows a side view of the profilometer as it is being calibrated. The instrument consists mainly of a carriage frame of wooden members mounted on 16 pneumatic-tired wire wheels and carrying in its exact center the recording devices. These 16 wheels, 8 on each side, are controlled by a steering mechanism so that all pavement, regardless of curves common to highway construction, may be tested with the same ease as straight pavement. The instrument is 18 ft. in length from center to center of the wheels and 3 ft. in width from rim to rim of the wheels. The profilometer is operated by pushing or pulling in the desired direction, steering being accomplished by a simple control operating all wheels through the desired angle. The record obtained by use of the profilometer is a chart representing the profile of the surface of the pavement over which the instrument is moved.

The recording mechanism shown in Fig. 2 is located at the center of the profilometer and consists of a strainagraph equipped with a movable chart. The recording arm of the strainagraph registers any vertical irregularity in the pavement surface and is actuated by a vertical rod about 30 in. in length equipped on the lower end with a hard rubber roller held continually in contact with the surface of the pavement by a spring. A second recording arm actuated by an electro-magnet has been added for the purpose of making special notations on the chart. To call attention to any feature of the record the operator may cause any number of small vertical deviations from the straight line drawn by this second recording arm by operating the electro-magnet which is controlled by a push-button mounted on the frame. This is an added feature of the profilometer record found to be very valuable in many cases. The space record, made by horizontal movement of the chart, is obtained by a belt mechanism which drives the pulley on the strainagraph by a pulley attached to a second small rubber-tired wheel in contact with the pavement surface. This second drive-wheel is mounted on a toggle joint so that it may be raised out of contact with the pavement and horizontal movement of the chart stopped when no record is desired.

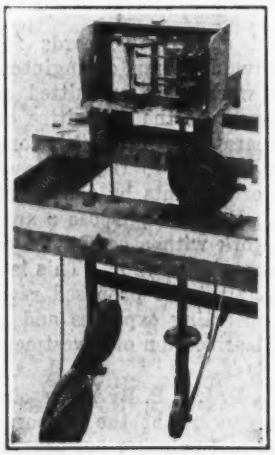


FIG. 2—RECORDING MECHANISM

A second recording device termed a "totalizer" has been added to the profilometer for the purpose of obtaining an index of the roughness of the pavement. This

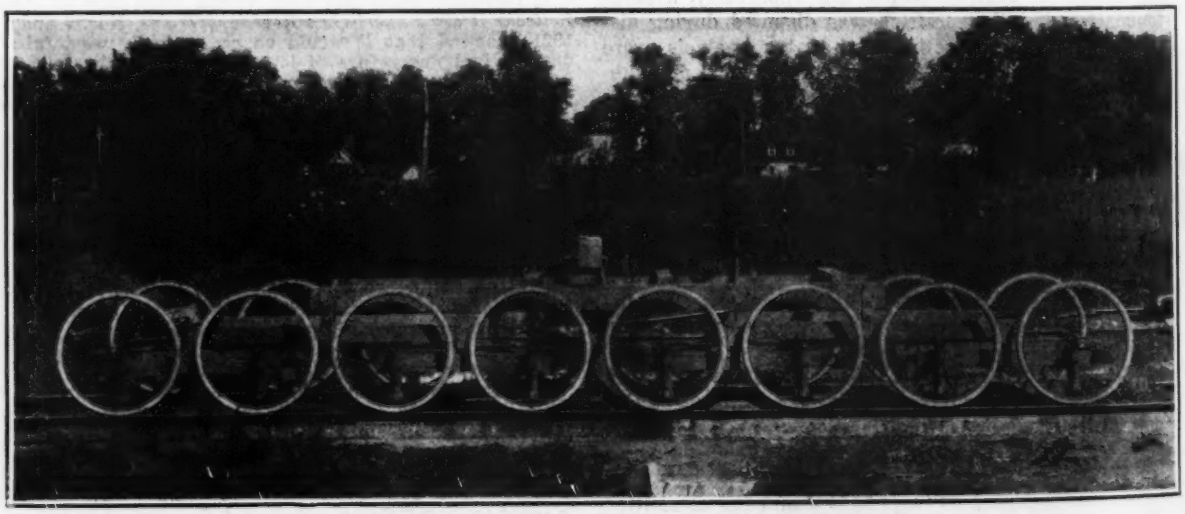


FIG. 1—PROFILOMETER AND TRACKS USED FOR CALIBRATION

device consists of a gear and ratchet mechanism, actuated by the same vertical rod used for the strainagraph, which furnishes a summation of the irregularities recorded on the strainagraph chart. This total roughness or summation of vertical irregularties in a unit distance has been found to be a valuable criterion of the riding qualities of any pavement. The figures given below illustrate the possible application of the "totalizer" and the significance of the results obtained by its use.

Riding Quality	Total Roughness, In. per 100 Ft.
Excellent	.0 - .66
Very good	.66-2.19
Good	2.19-3.78
Fair	3.78-4.74
Rough	4.74-9.46

Preliminary calibration of the profilometer was made on a track of carefully leveled I-beams with the use of obstructions of predetermined dimension. These obstructions were placed in the path of the recording wheel at measured intervals and after several trial records were made of the profile formed by these obstructions each record was found to check exactly, in both vertical and horizontal movement, the predetermined dimensions. A further calibration was made to determine the magnitude of error introduced into the record by a vertical movement of any wheel in passing over an obstruction. The same obstructions of predetermined dimension were again used and the error caused by a wheel passing over them was found to be negligible. This fact is apparent from the construction of the apparatus which allows for the compensation of any error. The wheels on each side are mounted by coil spring suspension in pairs on four trucks or equalizers. At the centers of these four trucks are suspended the ends of two longer trucks and to the center of these two longer trucks are suspended the ends of the main frame of the carriage. These series of trucks or equal-

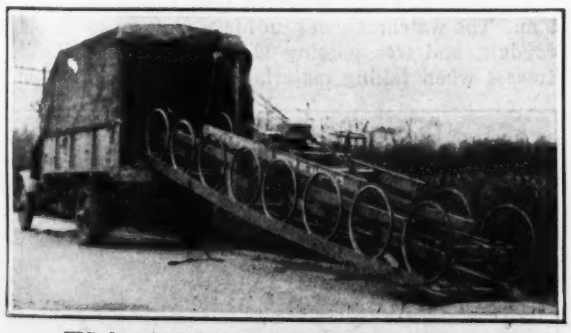


FIG. 3—LOADING PROFILOMETER ON TRUCK

izers act as levers which lessen the error, caused by an obstruction occurring under a wheel, in a geometric proportion having a ratio of two, so that an obstruction of 1 in. under any wheel causes a movement of ½ in. at the center of the main frame member. Since the recording apparatus is mounted half way between the two sides this movement is reduced to ¼ in. or an error of 6.25 per cent which is taken care of by the suspension springs.

Since the preliminary tests, the profilometer has been operated over some 25 miles of various types of pavement in Illinois. The instrument is transported on a truck, is loaded and carried by a special frame (Fig. 3) and may be moved safely to any location.

Fig. 4 shows the records made on several types of pavement and is included to illustrate the variation in the records obtained on these different types and the comparisons it is possible to make. Since the institution of precise surface testing apparatus in Illinois there has been an appreciable tendency toward better finishing of pavement surface on the part of the contractor. This has been demonstrated by the records taken over both the new and previously constructed sections.

In addition to general observations and the records made to check the work of the straight-edge which is

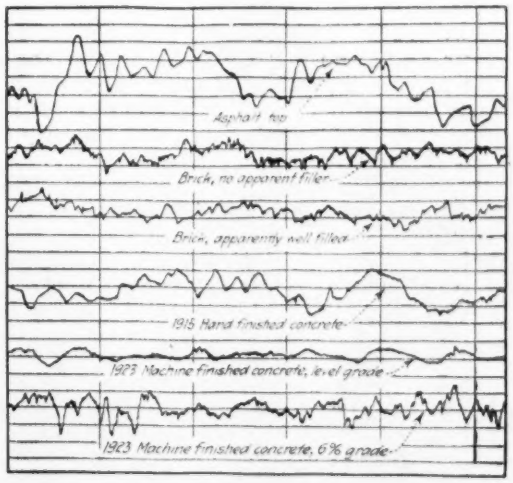

Asphalt top
Brick, no apparent filler
Brick, apparently well filled
1913 Hand finished concrete
1923 Machine finished concrete, level grade
1923 Machine finished concrete, 6% grade

FIG. 4—PROFILOMETER RECORDS TAKEN ON SEVERAL TYPES OF PAVEMENTS

still being used in the location of "high spots," the Illinois profilometer will be employed in the investigation of surface phenomena such as periodic waving and hair checking. Due to its accuracy the instrument will also find use in the many experiments now under way or planned by the department.

Further investigational tests embracing about 300 miles of various types of pavements will be made within the next few months after which the instrument will be adopted for the routine testing of finished pavement surface.

A Non-Deflecting Rail Joint

A base-supported non-spliced rail joint designed to prevent deflection of the rail ends has been suggested as a substitute for the usual bolted splice arrangement in a paper before the British Permanent Way Institute by Sir Bradford Leslie, an engineer of long experience on the railways of India. For this "non-deflecting" rail joint, two shoulder ties 12 in. wide are placed 24 in. apart and have mortised into them two 24-in. blocks under the rails, the shoulder ties being also held together by two tie-rods through the ends. Upon each 24-in. block is a shoulder tie-plate 18 in. long, to which the rail ends are secured by four screw spikes or drive spikes on each side. These spikes constitute the only joint fastenings. Ordinary tie-plates and similar spikes are used on the shoulder ties. The base-supported type of joint is not new and has been made in various ways, but the novel feature in this new arrangement is the elimination of all splicing of the rail ends.

Failure of Gleno Dam Charged to Buttress Shear

Study by Swiss Engineer Finds Cause in Weakness of Defective Buttress Concrete Under Shear and Tension

BUTTRESS shear is charged with primary responsibility for the disastrous failure of the Gleno dam in upper Italy by a Swiss engineer who studied the situation on the ground, Dr. A. Stucky, of Basel. His report, published in the *Schweizerische Bauzeitung* of Feb. 9 and Feb. 16, gives facts and analyses that supplement the report published in *Engineering News-Record* of Jan. 31, p. 182. The stresses in the buttresses do not appear to be in any way abnormal, but the concrete appears to have been of such poor quality as to be incapable of resisting them. The suggestion is made that settlement of the rubble base of the dam may have

FIG. 1—BREAK IN GLENO DAM SEEN FROM SOUTHWEST
Looking upstream. End of outlet conduit through masonry base visible near lower center of picture.

promoted the failure, but failure of the base is stated to be not the primary cause of the disaster.

As to the location and construction of the dam, Stucky states that the structure, which was built across the head of the valley of Gleno Creek, a tributary of the Dezzo, was to provide about 4,850 acre-ft. of storage to supply five power plants between the dam and the town of Darfo. The two upper plants belong to the owner of the dam. An aggregate head of 4,250 ft. was utilized by the five plants. The dam was begun in 1920, and was used for impounding water even during its construction, to permit earliest possible operation of the upper plant. Construction was completed during the summer of 1923, and on Oct. 22 the reservoir reached full level for the first time. It remained substantially full up to the time of the accident.

The foundation rock is described as excellent, in spite of moderate seaming or fissuring; "a better foundation could not have been asked for." The upper surface of the cliff still shows well defined glacial planing.

The dam was about 800 ft. long and on most of its length ranged from 80 to 100 ft. high, but in the narrow central gorge the height was about 160 ft. The cellular concrete superstructure was 88 ft. high from base to full pool level, including the widened rubble footing courses of the buttresses, 6 or 7 ft. high. The gorge itself was closed off by rubble masonry base block of trapezoidal cross-section, but from the conditions it does not appear that this base represents an early intention to build a gravity dam.

A large sluiceway pierced the rubble base. This opening was 13 ft. wide by 30 to 35 ft. high. Stucky does not consider this opening to have any bearing on the accident, because the initial break occurred at a distance from it and the conduit is still to be seen. He also states that the entire rubble base is relatively little damaged, aside from injury by the outrushing water and the falling material from above.

Construction—Nothing was done to prepare the surface of the foundation rock to receive the structure. Obviously it should have been stepped off and the smoothly planed natural surface, where level enough to be used direct, at least roughened for bond. Stucky describes the rock surface as so smooth that the mortar could not adhere, and forms the opinion that even before the accident the dam had no bond with its foundation, but merely rested on it. He states that alongside the destroyed portion of the dam a separation between masonry and rock foundation of as much as ¼ in. is visible and that similar separation occurs at other points along the dam. The anchorage was entirely inadequate in amount and cross-section (note anchor bars in Fig. 2).

Lime mortar was used in laying up the rubble base; but some doubt concerning the propriety of using this material appears to have arisen later, and cement mortar was used in the upper portion. The concrete of the cellular superstructure is described as of poor appearance, judged both by the standing concrete and by the broken fragments, which indicate both weakness and porosity. The grading and washing of the aggregate is described as unsatisfactory. Nothing is said of the other materials. According to hearsay evidence, the concrete was mixed by hand.

Failure—The dam broke on Dec. 1, between 7 and 8 a.m. The watchman was on his way down to the sluice conduit, and was passing along the base of the buttresses when falling material and the appearance of a

FIG. 2—WEST END OF BREAK
At right, broken end of failed buttress; at left, toe of standing buttress; in foreground, sloping surface of rock on which toe of rubble base rested; lines are drawn to indicate original upper surface and toe line of rubble base. The accident is not attributed to primary failure of the base.

vertical line or shadow on one of the buttresses caused him to run back. The pier broke just after he was in safety. This pier was the third one east of the westerly

(right-hand) large junction pier. This pier is gone. At this point the rubble base was only a few feet high.

Describing the conditions of the debris, Stucky says that the rubble base has lost some of its downstream face, but in general is fairly well intact. Of the westerly or right-hand section of the dam, some 400 ft. long, a number of piers and arches are damaged (cracked?). He concludes that the failure of the dam is not chargeable to a local defect, causing the failure of a single buttress, but to general weakness of the structure, and that the entire dam was in a weakened condition before the failure.

Judging from the way in which an arch sheared off clean at its springing line, at the left end of the dam (Fig. 5), the concrete is considered to have been very badly lacking in strength. Numerous leaks through the concrete evidence its porosity. Bond of concrete and steel was injuriously affected by large stones thrown into the concrete. Reports of men who were on the dam before its failure indicate that patching with mortar was resorted to to stop a number of the leaks through the concrete. Stucky cites as further proof of the low strength of the concrete the fact that the reinforcement generally stripped quite clean (as in Fig. 5) and that where such rods enter the standing concrete they have broken out funnel-shaped holes.

Cracks of particularly pronounced character are seen in the first standing buttress to the right of the break (Fig. 4). These are quite obviously shear cracks.

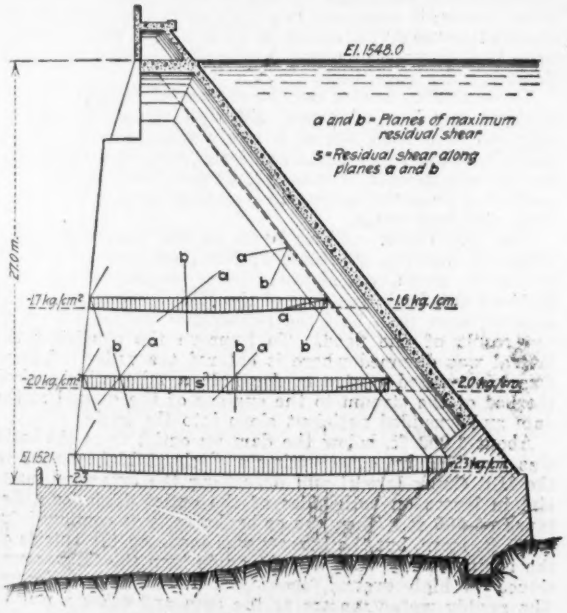


FIG. 3—RESIDUAL SHEAR IN BUTTRESS

Shaded areas represent shearing stress less internal friction, the latter taken at 0.75 times the compression on the plane considered. These residual shears are given for the planes on which they are maximum. The diagonal lines indicate the two planes of maximum residual shear at nine different points.

Stresses—From an analysis of the design made by drawing pressure lines and computing stresses on horizontal sections, Stucky finds no abnormal conditions. The pressure line is within the middle third, with a sufficient margin for the possible consideration of uplift, although this latter is considered to be of very minor importance in a dam of the present type. The compression on the horizontal section does not exceed 140 lb. per square inch. Fuller studies of stress distribution and maximum stresses, however, show less satisfactory conditions. Taking inclined sections, tension

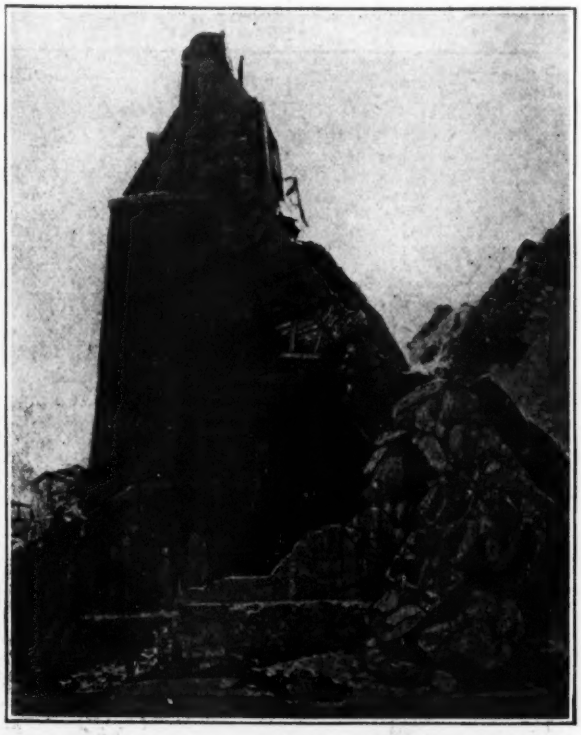


FIG. 4—CRACKS IN BUTTRESS AT WEST END OF BREAK

The general course of these cracks is in harmony with the direction of the planes of maximum residual shear shown in Fig. 3. In reproducing the original photograph, these cracks have been emphasized.

existed in the buttresses near their upstream edges, roughly parallel to the edge. These tensions correspond to top flange tensions of the buttress considered as a beam, supported at its base near the downstream edge and loaded with the distributed water load along its sloping top.

Calculations of maximum stresses do not indicate that the tensile and compressive stresses were important. The tensile stresses could not be considered serious even for weak concrete. The maximum horizontal shear was below 60 lb. per square inch. The maximum diagonal shear near the base of a buttress was about 70 lb. per square inch.

Calculations of the directions and amounts of the maximum diagonal shears after deducting the frictional component (taken as 0.75 times the compressive stress at right angles to the plane considered) showed the results sketched in Fig. 3, where the diagonal lines indicate the two directions of maximum residual shear at various points and the shaded areas give the amounts of these residual shears (21 to 23 lb. per square inch in the upper section, 33 lb. per square inch in the lower section). These shears, in conjunction with the tension near the upstream face of the buttresses, are considered to have exceeded the strength of the kind of concrete used in the Gleno dam. Attention is called to the general parallelism of the planes of maximum residual shear in Fig. 3 and the lines of cracking in the buttress, Fig. 4.

The conclusion from the study drawn by Dr. Stucky is that the buttresses were weak under shear even before the accident and probably contained shear cracks, indicating incipient failure. Failure would have occurred in a short time independent of any special

FIG. 5—FAILED ARCH AT EAST END OF BREAK
Buttress concrete blotchy and marked by construction joints.

inciting cause. However, he believes that percolation of water through the rubble masonry base may have caused enough leaching out of the lime mortar to weaken its supporting power and simultaneously set up a bursting pressure sufficient to change the stress conditions in the buttresses. This may have resulted in settlement of the masonry or in sliding on the rock surface sufficient to increase the already serious stresses in the buttresses to a fatal degree and bring about the destruction of the dam.

Government Sustained in Canal Action

In building a diversion canal from Mormon slough to the Calaveras River, a short distance above Stockton, Calif., the government did not appropriate land which subsequently might be overflowed temporarily because the canal was not sufficiently large to carry off an extraordinary accumulation of water, according to a decision by the United States Supreme Court Feb. 18. The land between the river and slough was low and subject to overflow. The government built the canal and protected it by a levee to remedy conditions. Stefano Sanguinetti sued after his farm had been overflowed following heavy rains. The evidence showed that good engineering practice had been followed in building the canal and levee. The Court of Claims held that Sanguinetti had no cause for action, and the Supreme Court upheld this ruling.

Silt and Silting Basins on Drainage Works

Control of Silt from Streams by Settling Basins—Intercepting Ditches Return Flood Waters to Channel

Abstract of a paper read before the National Drainage Congress by Roy N. Towl, consulting engineer, Omaha, Neb.

SILT DEPOSITS in ditches result in great damage to drainage districts and eventually affect railroads and other interests. For instance, in Fremont County, Iowa, the Burlington R.R. raised its main line 7 ft. at a cost of $36,000 to permit the construction of the Plum Creek floodway ditch to carry silt directly to the Missouri River. In Woodbury County, Iowa, the C., M. & St. P. Ry. has recently raised its bridge over the west fork of the Little Sioux River, and is planning other work, on account of drainage ditches which have been reduced in capacity by silt deposits.

Settling Basins—Settling basins have been misunderstood by some engineers, who have the idea that a reservoir must be made which will impound the flood water and practically stop the velocity and allow the mud to settle. They would provide for spillways and outlet structures. This is wrong. The best settling basin is the natural one; where the overflow spreads out, near the base of the debris cone or higher up, and flows out over the fan of debris in a shallow, broad sheet. This quickly reduces the velocity and drops the silt. Then the return of the flood waters to the ditch is accomplished by a lateral channel which should be at least ¼ mile from the overflow point, if the stream has a watershed of ten or more square miles. In other words, if a stream is permitted to overflow and discharge its entire volume out of its banks, it will ordinarily drop in a distance of about ¼ mile all the silt which would damage a drainage ditch.

These settling basins may be successfully farmed to corn without any loss of crops, although replanting may be required if a flood buries a newly planted crop. Floods provide hilling up material and irrigation. The slope made by the silt deposit is always sufficient to drain the land quickly if an outlet is provided, so that there is no damage from standing water.

The Hill Creek settling basin on the Burt-Washington drainage district, at Herman, Neb., encloses an area of about 40 acres, as shown in the accompanying plan. Without this basin the flow of the Hill Creek lateral would destroy more than half the capacity of the main ditch as the result of one flood. To improve the conditions the lateral was dammed where it entered the valley. A levee was constructed upstream for half a mile, which raised the bed of the stream to the surface of the ground at the dam and provided sufficient slope into the basin.

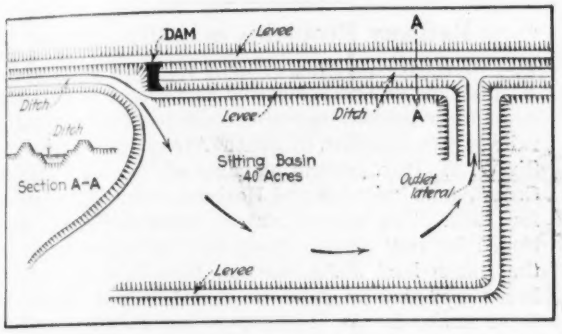
About 1,000 ft. below the dam an outlet from the basin was provided by constructing a ditch at right angles to the Hill Creek lateral and depositing the excavated material in levees on both sides of the outlet ditch for a distance of 600 ft. Then the embankment was continued for 1,100 ft. more, but the borrow was made on the outside of the basin; thence with a right angle turn the fill was continued to high ground, making a rectangular enclosure. The muddy water enters at the dam and takes a normal course, with a wide curve through the basin, to the outlet ditch. In floods, the water nearly fills the basin, but it discharges continuously and in a few hours the basin has entirely drained. The ground which was formerly springy has now been built up and solidified by the silt deposit and is used for pasture. This basin has been in operation for seven years and can be used for a least five years more, at which time the low ground adjoining on the north may be used to advantage. The average fill in this basin has been four inches per year for a period of five years.

Drift which enters a silt basin is sometimes a nuisance. A willow screen or open fencing near the point of overflow will collect the drift, or similar construction near the outlet will prevent trouble at that point.

For the economical construction of a floodway ditch, using a small dredge of 1- to 2-yd. capacity, the first step will be to make a wide, temporary floodway with levees

or embankments. The second step will widen and raise these levees on the inside, using the washed soil or sediment, which makes good watertight embankments not subject to failure by cracking like the ordinary gumbo found in low swales crossed by the flood ditch. The final ditch and levee construction, made in the filled ground, will have the desired grade and will be made secure with heavy embankments.

In this program, requiring several years, the cost will not be greater than the ordinary cost of a few years' maintenance work. The usual mistake is in trying to finish



HILL CREEK SILTING BASIN

the job in one trial. If the waste banks or levees are close to the ditch, leaving only an ordinary berm, it becomes necessary to level or remove them when a "clean-out" is made, which is expensive and unsatisfactory. We should have a better understanding of the cause of erosion and transportation of silt, so that there may be more stabilized channels and reduced cost of maintenance.

High Flood Discharges in India

High flood discharges from small mountain streams in India have just been reported by Lt.-Col. G. R. Hearn in a paper "The Effect of Shape of Catchment on Flood Discharge" before the Institution of Civil Engineers. Discharges exceeding 2,000 sec.-ft. per square mile were observed. For very small drainage areas, 10 sq.mi. and less, the author gives an approximate formula indicating the relation between intensity of rainfall and area, as follows: The maximum rate in second-feet (total flood discharge) is $Q = 640\ A\ (4\text{-}\log_e A)$, where A is in square miles. The author also considers that it is not possible to maintain the theory that maximum precipitation is some fraction of the annnual rainfall, as severe rainfall may occur alike in England, in the tropics, and in arid regions. He concludes that drainage areas of such shape as to give highest concentrations, as semicircular areas, may have a runoff two and one-half times as great as that of an area of ordinary shape. Other high flood discharges are reported by E. L. Glass in another paper before the same society, "Floods of the Damodar River and Rainstorms Producing Them," also relating to Indian experience. With a drainage area of 8,200 sq.mi. this river is subject to extreme floods from rainstorms lasting from three to six days, with a total rainfall over the entire area of from 3 in. in three days to a maximum of about 12 in. in six days. The estimate of maximum flood possibilities derived from these data is said to be not very far from the estimate based on the largest storms studied by the Miami Conservancy District in determining the limiting flood for designing the Miami River flood protection.

Sanitary Defects of a Well Water Supply

CORRECTABLE structural defects in a water-supply system having to do principally with the probability of accidents affecting the sanitary quality, are called sanitary defects in the tentative revision of the present Treasury Department standards. Although this standard is intended primarily for purposes of domestic quarantine, it is generally applied to all supplies as a basis of judgment. It is contemplated that the presence of these sanitary defects, as stated below, will be held sufficient grounds for refusing approval to a supply.

In Iowa J. J. Hinman, Jr., chief, Water Laboratory Division, Iowa State Board of Health, has just issued a bulletin to all the cities in his state urging the officials to scan the list and correct the defects found. He warns operators not to lay themselves open to charges of negligence, for the courts have held that failure to know the condition of a supply constitutes negligence.

As tentatively prepared by the sub-committee in charge of this phase of the standards, the sanitary defects are:

Ground Water Supplies

Caves, sink holes or abandoned borings used for surface drainage and sewage disposal in the vicinity of the source.

Lack of safeguards in preventing pollution when adding to or repairing works at source, such as putting in new wells, cleaning out wells, etc.

Immediate surroundings unprotected; poor surface drainage.

In case of dug wells, upper portion of well wall not impervious, cover of the well wall not tight.

In case of tubular wells, casings leaky, not extended to sufficient depth, casings not extended above ground or floor of pump room, not closed at top, use of casing as a suction pipe instead of having a drop pipe.

Collecting well or reservoir open not watertight, equipped with improper overflow, no drain for cleaning, drains subject to backflow of polluted water.

Leaky gravity mains.

Source of supply or structures subject to flooding.

Availability of impure emergency supply, emergency intake to stream.

Pumping of Supply

Leaky suction piping.

Pump not self-priming, unsafe water used for priming.

In case of air-lift wells, air release chamber exposed.

Suction well unprotected from surface, or subsurface contaminated.

Well subject to contamination from waste water or backflow through pump pit drains.

Distribution of the Supply

Existence of cross-connections with private or other impure supplies.

The return to the system of any water used for cooling, hydraulic operations, etc.

Inadequate protection or improper maintenance of distributing reservoir.

Intermittent service resulting in lowering pressure or negative pressure in distributing system.

New connections or lines joined to system without prior disinfection of pipes.

Water lines in close proximity to sewer mains within 6 ft. distance.

Existence of porous pipe in system.

Existence of gravity mains or mains in stream beds in which leakages have not been carefully guarded against.

Range of Salaries for Engineers at Present Time

FROM records kept for four months by the employment department of the American Association of Engineers, a tabulation of salaries paid technical men gives the average and range that may be expected at this time. The information includes data given by men who registered for employment seeking new connections, from men who joined the association, and from information obtained from industries, highway organizations, municipalities and individuals who had access to salaries paid. Salaries on most positions cover a wide range, but the general average was taken. The extremes on the salaries are not given. For instance, the city engineer of Chicago is rated at $8,000 per annum, whereas city engineers of many small cities receive as low as $300 or $500 a year and many city engineers and county engineers receive no set salary but a fee when engineering work is done. The city manager of Stockton, Calif., receives $20,000, whereas the city manager of Cynthiana, Ky., receives $1,200 a year. The average, however, is taken of cities ranging between 5,000 and 50,000 population. It is obvious that a sanitary engineer for such a city as Chicago would be paid a very much higher rate of salary than the sanitary engineer for the average city. Salaries vary according to supply and demand and location of position. An instrumentman in the southeastern states receives a lower rate of pay than an instrumentman on a similar class of work in the Northwest. Salaries paid structural detailers have been as high as $250 a month. Temporary work is usually computed at about 25 per cent more than permanent appointments. Foreign positions usually range from 25 per cent to 50 per cent more than similar positions here. Practically all field positions on railroads, highways and positions with consulting engineers carry expenses away from headquarters.

RANGE AND AVERAGE OF TECHNICAL SALARIES

Position	Monthly salaries Range		Av.
Highway Engineering			
Chief engineer	$300-	$1,000	$450
Assistant chief engineer	225-	400	280
Bureau heads	200-	600	340
Assistant bureau heads	175-	300	230
Division engineers	225-	350	300
Assistant division engineers	180-	250	225
Engineers, special assignment	180-	250	225
Resident engineers	180-	250	225
Designers	190-	225	210
Draftsmen, checkers	150-	190	180
Party chief, project engineer	150-	225	210
Instrumentman, inspectors	135-	180	175
Rodmen	100-	140	125
Tracers	100-	140	125
Chainmen	90-	125	115
County Engineering			
County engineer	150-	400	240
Assistant county engineer	135-	200	175
Draftsmen	140-	200	175
Instrumentmen	125-	200	160
Municipal Engineering			
City engineer	150-	500	280
Assistant city engineer	140-	250	180
Sanitary engineer	175-	300	250
Engineer design	225-	300	250
Draftsmen	135-	175	150
Rodmen, chainmen	80-	125	100
Railroad Engineering			
Chief engineer	300-	1,000	600
Principal assistant	225-	600	400
Department heads	250-	600	400
Assistant department heads	200-	400	300
Resident engineers	200-	350	280
Roadmasters	250-	275	250
Assistant roadmasters	175-	200	180
Assistant engineers, office or field	175-	300	250
Engineer accountant	225-	350	250
Valuation department, general	150-	225	190
Chief draftsmen	250-	350	275
Leading draftsmen	200-	275	240
Designer, locomotive	210-	260	225
Bridge or steel designer	200-	260	240
Party chief	175-	260	225
Instrumentmen	150-	225	190
Draftsmen	150-	200	180
Tracer	115-	140	125
Rodmen	115-	160	130
Tapemen	90-	125	110
Miscellaneous			
Designers, estimators, sales, bar co	200-	300	250
Designers, Ht. & Vent	210-	240	225
Promotional engineers	200-	400	300
Sales engineers	150-	250 (plus)	
City managers	250-	500	
Chemists	125-	175	150
Chemical engineers	150-	300	250
Ceramic engineers	175-	400	250
Valuation engineers, utilities	200-	400	300
Appraisal engineers, industrial	175-	250	200
Valuation listers	150-	200	160
Superintendents, construction	300-	700	400
Engineers, construction	200-	400	300
Assistant construction engineers	175-	300	250
Instrumentmen, construction	125-	200	160
Rodmen, construction	100-	150	135
Estimators, construction	200-	400	275
Construction draftsmen	150-	250	200
Map draftsmen	140-	200	175
Topographers	175-	250	200
Architectural engineers	300-	700	400
Architectural draftsmen	160-	300	225
Squad boss, steel	250-	350	300
Designers, all classes	200-	325	260
Detailers, all classes	150-	225	180
Tracers, all classes	125-	150	135
Mechanical engineers	200-	600	400
Mechanical designers	200-	300	250
Mechanical draftsmen	125-	200	190
Electrical engineers	200-	400	300
Junior electrical engineers	125-	175	160
Professors	200-	500	325
Associate professors	200-	400	300
Assistant professors	200-	350	275
Instrumentmen, general	150-	225	200
Research engineers	175-	250	210
Industrial engineers	250-	500	400
Technical editors	300-	600	400
Technical writers	150-	300	250
Technical student training	100-	125	120

Railway Problems in South Africa

ECONOMIC handling of light traffic in thinly settled districts and of heavy and fast traffic on important main lines present opposite conditions encountered in railway development in South Africa, as reviewed by Sir W. W. Hoy, general manager of the South African Government Railways and Harbors, in his annual report for 1923. The government is being continually petitioned for new pioneer lines, but the report points out that much land along existing lines is still unsettled. It is urged that an endeavor should be made to develop these lands, in the interests of the railways and the state.

As to branch lines, special attention is being given to reducing the cost of operation by using rail-motor vehicles, reducing train mileage by the use of heavier engines to handle heavier trains, and by withdrawing the staff from stations having only a light business. Road motor service is operated in a few districts by the railway administration and generally with fair success. This service is considered desirable in many other cases where the cost of even a light railway is prohibitive, but a difficulty exists in the lack of suitable roads. Private lines of this kind are operated in some sections in competition with the railways, but the report points out that these independent lines should be regulated as to service and charges.

Electrification—Electrification of the heavy-traffic main-line division between Glencoe and Pietermaritzburg, 171 miles, with 245 miles of track, is making good progress and it is expected to have a 73-mile section in operation before the end of 1924. With the proposed electrification of the Cape Town-Simonstown suburban service it is expected to reduce the running time and provide additional trains, thus promoting a substantial increase in traffic. Double-tracking and grade reduction are being carried on at several points of the railway system.

A dry dock at Durban, which will be one of the largest in the world and will be completed this year, is the most important development in the harbors under the South African administration. This dock will be 1,150x110 ft., with 41 ft. of water on the sill. Vessels with drafts of 24 ft. to 32 ft. 9 in. enter this port. Grain elevators of 42,000 and 30,000 tons capacity are being built at Durban and Cape Town respectively.

Magnetic Separator for Refuse Destructor

The urban district council of Tottenham, England, has awarded a contract for a plant to handle clinker at its refuse destructor. The plant will include crushing, elevating, grading, magnetic separation, and storage facilities. It will be built by Vickers, Ltd., at the company's Barrow-in-Furness works. The specifications for the clinker plant were drawn by H. F. Wilkinson, engineer to the district council.

Progress and Developments in Railway Engineering

Various Subjects Covered by Abstracts of Committee Reports Presented to the American Railway Engineering Association at Its Annual Meeting, March 11-13

Construction Costs Chargeable to Maintenance

Committee on Roadway

GREATER costs are incurred in track maintenance (aligning, surfacing, gaging and shimming tracks, tightening track bolts and track spikes) during the period of operation immediately following construction than during the period after the roadbed has become seasoned. On one road these costs averaged $628 per mile of main track per year during the first five years of operation and $344 during the next five-year period. The latter represents normal conditions and the comparison gives a total difference of $1,419 per mile of main track for the first five years. This sum represents that part of the cost of keeping track in line and surface caused solely by the seasoning process, before the effect of changes in volume of traffic and other influences are eliminated. This $1,419 is the unadjusted "deferred track construction cost." A comparison between two similar lines gave $970 per mile of main track.

The expression "deferred" does not imply that these costs should have been incurred during the construction period. These are construction costs which must inevitably accrue after operation begins. It is not optional with the railroad whether or not these costs be incurred. They are costs of producing a seasoned railroad. They are not recurrent and, therefore, should be a capital charge. They do not include wholesale renewals of ballast or rails, or other unusual program work.

These studies indicate that the seasoning period has an average length of a little over five years.

* * *

Unit Costs in Track Maintenance

Committee on Records and Accounts

IN SHOPS the piece-work plan is directly applicable; in maintenance-of-way work a modified piece-work or a bonus plan is better, since production is usually measured for a gang rather than for an individual. The use of such plans in maintenance-of-way work does not necessarily involve the payment of additional compensation, though ideal results would be attained only when such an end was successfully and practically accomplished. It has been found that the very establishment of a standard performance has had a beneficial effect and that gangs that are the subject of time-study or have been made acquainted with results of such studies have been inspired to match the standards and the results accomplished by other gangs.

Conclusions—(1) The making of time studies and the comparison of performances of an individual gang with a standard, increases the efficiency of the gang under observation and of other gangs which are made acquainted with results. (2) The general use of standard methods and units of measure of performance on divisions and districts of a railway has resulted in increasing the efficiency of track forces.

* * *

Effects of Heavier Loads on Roadbed

Committee on Roadway

OWING to heavier quipment and increased tonnage i seems that in practically all sections of the country some trouble is being experienced with roadbed previously stable. Some of the larger coal roads are now handling cars with an axle load at least approximating that of the locomotives. The principal effect noted has been the deformation of the roadbed or adjacent ground and the development of water pockets in both cuts and fills. This results in irregularities in line and surface of track, with consequent abnormal strains on ties, rails and fastenings.

Remedies are suggested as follows: (1) The subgrade should be kept as free from water as possible. In many cases, sewer pipe subdrainage has been successful. Intercepting ditches will aid in keeping the water away from the subgrade. (2) Widening the roadbed will insure a better bearing on the ground under the embankments and help to stabilize the fills. It will provide more ditching room in cuts and permit better ballast drainage, also a greater area of saturation for rainfall. (3) Better distribution of the load can be accomplished by increasing the depth and quality of ballast, increasing the number of ties per rail, increasing the weight of rail, and paying more attention to the bolting, surfacing and tamping of tracks.

Problems of this nature are local, being especially acute where the roadbed is constructed of, or on, material easily made unstable by wet weather. The extent to which remedies can be applied is often limited by the amount of expenditure. But it costs much money in labor to properly protect operation over unstable points in the roadbed and track, while a comparatively small amount spent for remedy will, as a rule, earn good returns.

* * *

Cost-Keeping Methods

Committee on Records and Accounts

ABLE discussions of fundamental principles of cost-keeping methods may be found in some of the excellent books listed in the bibliography of 1920, but what is of more vital interest under this topic is what is it costing the railroads to do certain work per unit. The fundamentals for this purpose are few and simple and consist of a record of all the units of material used and their costs, with all the costs for applying such material to a definite location with proper credits, if any, for material salvaged. If an analysis of the accounting for a certain class of work under study shows that this information is not readily available, then the cost per unit cannot be ascertained until the accounting is made to fit the requirements.

Cost-keeping is used to ascertain cost of work done, but such records are of value not only for a particular period and location, but may be used to greater advantage to make comparison of costs, one period with another or one location with another. The number of cross-ties renewed, tons of rail laid or number of trackmen-hours worked for a given period are of interest and value as a record. But their real value is had, as with costs, when the record of such statistics is shown in comparison with performances of other periods.

* * *

Value of Water Treatment for Locomotives

Committee on Water Service

THE AMERICAN Railway Master Mechanics Association in 1873 reported that the average difference in boiler maintenance between bad-water and good-water country was $750 per locomotive per year, this being made up of: coal (at $2.50 per ton) $340; boiler repairs, $360; and cleaning, $50. Boilers have so increased in size, and repairs and cleaning have so increased in cost, that similar figures for today are easily $3,600. Where waters are only moderately hard, or in other respects vary only slightly from perfect boiler water, the damage done is mostly in fuel, boiler repairs and cleaning; and such measurements as the above apply quite well. But when the water is of a kind to cause leaking on the road, it frequently happens that the delays to traffic are of nearly as much money value as the waste of fuel and damage to the boiler. On one engine district in the bad-water country, the installation of treated water is saving $5,000 per engine per year in fuel and repairs and $4,000 per engine per year in other operating expenses, a total of $9,000 per engine per year.

The money value of the damage done to railroad revenues by the use of boiler-waters only moderately unsuitable has been much underestimated. This issue has been befogged

by the custom of keeping a locomotive on a bad-water district for three or four months, then transferring it for the balance of the year to a good-water district, and distributing the repair charges according to the time. A boiler using water of 13 grains per gallon hardness suffers damage in fuel and boiler repairs and time lost, to the amount of 13c. per pound of scale.

There are in use on various railroads partial treatments of boiler-water, some outside the boiler and some inside, which are cheaper than complete treatment; and the committee is endeavoring to determine their range of usefulness and the point at which the damage still remaining will justify the expense of complete chemical treatment.

* * *

Movement of Rails in Joints

Committee on Rail

OBSERVATIONS of expansion in track at periodic intervals under conditions of both dry joints and lubricated joints indicate that without lubrication most of the expansion is concentrated in a relatively small percentage of the joints, with consequent wide gaps during the contraction phase at these locations. With lubrication of the contact surfaces the movement appears considerably more uniform.

Laboratory tests on fully bolted joints, the bolt tension being approximately 13,000 lb., show that the theoretical forces developed by a temperature change of approximately 12 deg. should suffice to slip the rail. It seems probable that this tension is being frequently exceeded in an effort to maintain joints to their maximum efficiency as a girder, the result being a locking of the rail against expansion slip in many joints. The expansion thereupon travels until a relatively loose joint is encountered, with consequent batter at such points through improper spacing. A balanced standard of bolt tension might be possible under which the mechanical strength of the joint could be conserved without unduly restraining slip.

* * *

Wheel Taper and Canting of Rail

Committee on Track

TAPER of the wheel tread is not largely the cause of the lateral force on the rail. The expense of regaging track is largely due to the lateral force on the rail. There are three ways in which the expense of regaging track may be substantially reduced: (1) By a proper design of tie-plate providing more bearing area outside of the rail than inside of the rail; (2) by canting the rail, using a tie-plate with an inclined upper surface; (3) by the combination of both the above. Prof. A. N. Talbot, of the committee on Stresses in Track, has agreed to make tests to determine the effect upon stresses of placing the rail in the canted position. The committee on Wheels, of the mechanical division of the American Railway Association, has passed a resolution that no change can be justified in the present standard wheel taper of 1 in 20.

* * *

Bituminous Paving for Road Crossings

Committee on Signs, Fences and Crossings

THE MAJORITY of bituminous crossings now being installed and using crushed stone as an aggregate are of the type that does not require heating the bitumen, and the specifications presented apply to this type. The question of flangeways is important. Some roads have found flangeways of other materials necessary, while others have had but little trouble where the bituminous concrete is laid in contact with the rail and the wheels are allowed to cut a flangeway. Those who use the latter method claim that special flangeways of wood or steel permit water to get under the crossing and cause its failure. Where special flangeways are not used, the crossing sometimes breaks down next to the rail and the drop of vehicle wheels from the top of the rail to the farther edge of the flangeway widens the flangeway and tends to make the paving material roll up toward the center of the track. The amount and character of highway traffic should have consideration in determining whether special flangeways are necessary. Some roads are using successfully a thinner layer of the bituminous concrete than the four inches called for in the committee's specifications.

* * *

Premixed Aggregate for Concrete

Committee on Masonry

THE New York Central Lines West has used premixed aggregate in a number of cases and reports satisfactory results. Its engineers are careful to have the aggregates properly mixed before delivery on the work and to prevent separation in handling. The following comments of B. R. Leffler, bridge engineer, based on the experience of this road, are of interest: "In unloading premixed aggregate, the material should be deposited in horizontal layers until the top of the cone or pile is reached. The material should not be dumped by what I call the "cone" method. By this I mean starting in the middle of the pile first, and enlarging outward to the circumference and top. This objectionable method would tend to make the coarse material roll down from the peak of the cone formation to the outer surface and bottom."

* * *

Steel, Concrete and Wood Fence Posts

Committee on Signs, Fences and Crossings

SEVERAL roads reporting recent installations of steel posts are unable to give an estimate of probable life, but this indicates increased general use of steel posts. Steel posts set in wet or swampy ground have a short life, five to eight years being the total reported for some posts. The manufacturers generally claim a probable life of from 20 to 25 years and the data seem to show this is about what to expect. Apparently the tubular, L-shaped or T-shaped posts will give about the same life under similar conditions.

The estimated life of concrete posts put in from 1913 to 1917 is reported as indefinite, present condition of posts good and failures few. Posts erected prior to 1913 were more or less experimental in either material or manufacture and failures were many. Since 1913, concrete fence posts have been built along the lines of reasonably correct design and workmanship, and in view of the small number of failures in these later posts, it seems reasonably safe to assume for them a probable life of 50 years.

Generally speaking, the wood post seems to hold its own with either steel or concrete, especially where local conditions as to fire or other destructive elements are favorable, and particularly where wood is plentiful and the cost low. Local conditions would seem to be a large factor in determining which kind is the most economical.

Averages of life and cost of three kinds of posts are tabulated below.

Kind of Post	Est. Life Years	Cost Installed Cents	Annual Cost Cents
Concrete	50.0	70	4.4
Steel	22.5	58	4.7
Wood, average	23.7	52	4.1
Wood, cedar	23.9	50	4.0
Wood, min. life	12.0	41	4.8
Wood, max. life	30.3	38	3.4

* * *

Vacuum Cleaner for Track Ballast

Committee on Ballast

THERE is being developed a ballast cleaner on a new principle and through the kindness of W. G. Coughlin, chief engineer maintenance-of-way, eastern region, Pennsylvania Railroad System, we describe the device.

This machine will consist of a 250-hp. steam turbine, connected to a rotor which will exhaust the air from a large expansion chamber, creating a partial vacuum. The entire machine will be mounted on a flat car, at the end of which three telescoping 8-in. pipes will extend downward to the ballast level, their upper ends entering the expansion chamber. The machine will be drawn by a locomotive which will also furnish steam to the turbine. In operation, the locomotive will uncouple from the ballast cleaner and advance 12 ft. It will then act as an anchor while an auxiliary steam engine on the cleaner will pull the cleaner to the locomotive by a chain, after which the locomotive will advance another 12 ft. This secures more uniform movement.

The three telescoping inlet pipes include one between the rails and one outside each rail; all three automatically move laterally as the car moves forward. The center pipe will travel from rail to rail and the outside pipes will reach to a point 2 ft. 3 in. from end of tie. It is expected to lift ballast and dirt through the three pipes. The dirt will be screened out in the expansion chamber and will be deposited in a temporary storage chamber, from which it is removed at intervals, while the stone will pass through a discharge valve which operates similar to a revolving door, letting the ballast out but not allowing air to enter. This will return the ballast to the track at a point less than 15 ft. from where it was taken out. The machine is being built by the Pneumatic Conveyor Co., Philadelphia, and is expected to clean one mile of single track per day of ten hours.

* * *

Changes in Size of Ties

Committee on Ties

THE SIZE of ties most widely used under heavy traffic (main track in main lines) has increased since 1905 from 6x8 in. x 8 ft. to 7x9 in. x 8½ ft. Owing to the many variables involved, including strength of timber in its average condition in track, condition of road bed, etc., it is not possible to calculate a design for a tie in the sense that a bridge member is designed. For heavy traffic, ties should have a minimum thickness of 7 in., a maximum width of 12 in. and a length of at least 8½ ft. or possibly 9 ft. A space of 10 in. between tops of ties allows sufficient room for tamping; the maximum of bearing area on the ballast may be secured by use of the wider and longer ties laid with this spacing.

* * *

Curving of Rails Before Laying

Committee on Track

INFORMATION from twenty railroads indicates a wide difference of opinion as to the limits of curvature for which rail should be precurved, and the class of track on which it should be used. Four railroads have discontinued the practice. Four precurve for only curves of such large degree that they are usually found only on light traffic branch lines or sidings. Three report precurving, but have very few curves that come within the required limits. The roads following the practice of precurving can give no data as to economies effected in labor or materials, but are of the opinion that precurved rails maintain better line and gage than rails lined to the curve when laying. The practice of precurving rail is gradually being discontinued, and the following recommendation is submitted for the *Manual:* Except on very sharp curves, much sharper than usually found in main line curves, rail need not be curved before laying.

* * *

Types of Platforms at Different Terminals

Committee on Yards and Terminals

THE STUDIES of the committee have been directed toward determining the proper size and relation of platforms to suit the volume of different kinds of traffic at typical stations. Three general types of platforms were considered; those used for combined passenger and trucking service, exclusively for passengers, and exclusively for trucking.

The study of the action of passengers on the platform of a through station resulted in some very interesting diagrams showing the position and density of the passengers at short intervals of time, and demonstrated the need of a different type of platform for through and suburban traffic. The studies were continued to include congestion at stairs with diagrams of movement.

* * *

Instructions to Engineer Field Parties

Committee on Rules and Organization

IN ORDER to clarify and make the instructions to engineering field parties more definite the committee has entirely rewritten the instructions now contained in the manual. The committee also has submitted revised rules for the guidance of maintenance-of-way employees, rules for handling explosives, and for accidents and first aid.

* * *

State and Federal Requirements for Grade Crossings

Committee on Signs, Fences and Crossings

A VERY pertinent contribution to the information on the requirements of the federal and state governments for highway grade-crossing elimination is presented by the committee in its resumé. It includes data concerning federal aid, the general policy of the Bureau of Public Roads, and a statement by states of the regulations and method of distributing the cost of grade-crossing elimination.

* * *

Preservation of Timber and Ties

Committee on Wood Preservation

AFTER a year and a half of study of the possibility of mixing creosote with other oils a sub-committee has presented a full report giving a history of experience abroad and in this country with such mixtures. Three considerations justify the admixture of petroleum with coal tar creosote: first, reducing the initial cost; second, increasing the value of the treatment by bringing about a better distribution of the creosote; and third, reducing the checking of ties. But while it is undoubtedly true that the mixture of crude petroleum with creosote will reduce the checking and will reduce the cost of treatment the committee is not yet prepared to state that the process will not reduce the toxic value of the creosote and thus partially defeat the object of treatment. This can only be learned by experience.

Overhead Street Crossings Proposed for London

London Correspondence

THE latest proposal to receive the serious consideration of the traffic authorities in London to relieve the intolerable traffic conditions is the construction of overhead street crossings at congested traffic centers. This proposal has been very freely criticized in the press on the basis of impracticability and ugliness. It it pointed out that an elevated crossing would require to be 20 ft. wide at the least to permit one stream of traffic either way, the suggestion being that the elevated should be utilized by fast traffic while the slow-moving vehicles are to remain on the ordinary road level. The proposer of the scheme, Sir Alfred Yarrow, maintains that a width of 16 ft. is ample, as the buses are only 7 ft. 3 in. wide, leaving a margin of 18 in. He suggests a road width of 18 ft. with 18 in. on either side for the structure, making 21 ft. in all. Where the first elevated would be built, at the crossing of Oxford and Regent Streets, the roadway is 55 ft. wide, thus leaving 17 ft. of road on either side of the elevated crossing.

The grade of the crossing is put at 1 in 13, which is one easily negotiated by buses. The clearance between the road surface and the underside of the elevated crossing is put at 16 ft. 6 in., or sufficient to allow 1 ft. clearance above the head of a 6-ft. man standing on the top of a bus. With a height of 16 ft. 6 in. and a grade of 1 in 13, the length of approach with grade is 213 ft., which is quite a workable length.

The scheme is receiving the support of many eminent engineers but the public on the whole is strongly opposed mostly on the ground that it will destroy what little beauty remains to London after the rebuilders have done with it.

Vienna Builds Remarkable Power Project on Ybbs River

Collapsible Weir Dam—Six Miles of Tunnels, One Syphon and Two Aqueducts in the Conduit—Unusual Type of Surge Basin—Penstock Carried on Slide Bearings

By Otto Lemberger
Munich, Germany

AS A FIRST step in an undertaking to provide the city of Vienna, Austria, with 100,000 hp. of hydro-electric energy to replace its existing steam plants, an organization founded by the city of Vienna and the larger banks, known as the *Wasserkraftwerke Aktiengesellschaft* or the "WAG," has undertaken the construction of a hydro-electric plant on the Ybbs River, which by means of a conduit 6.8 miles long, across a big S in

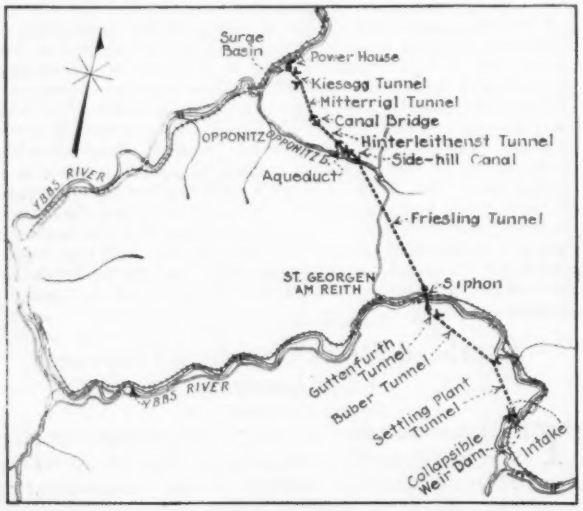


FIG. 1—LOCATION OF DAM, CONDUIT AND POWER PLANT

the river, will develop a total head of 415 ft. The power so developed will be stepped up to a voltage of 110,000 and transmitted a distance of 84 miles to Vienna. On account of the unsettled financial conditions in Austria, the contracts for the work were let on a cost-plus basis.

The first problems to be solved were those of access to the various sections of canal and tunnel, to the dam and power house, and the provision of housing for the workmen. The construction work on the conduit was let in three separate contracts and each contract section was provided with its own barracks and construction camp. The power house site was reached by means of a spur track carried across the Ybbs River on an Austrian war bridge. As the tunnels were located high above existing roads and railroads, and as they were worked not only from the ends but from many side headings, it was necessary to build inclined railways to get supplies to the various headings. An incline was also used to build the penstocks and the surge basin. This latter incline was 626 ft. long and ascended a vertical height of 346 ft. Power for the construction work was supplied by two 500-volt steam driven generators, supplying a transmission line seven miles long, and by two Diesel engines and three steam engines at isolated points.

The Dam and Conduit—On account of the sudden freshets in such Alpine rivers as the Ybbs, it was decided to make the main dam a movable structure using a system of automatically collapsible weirs devised by Huber & Lutz of Zurich, Switzerland. There are two such weirs across the main channel, each 52 ft. 6 in. long, and one sediment sluice 13.1 ft. wide. One weir is 6.6 ft. high and the other is 9.2 ft. These weirs are so arranged that when the water level reaches a height of 2 in. above the crest the weir will collapse under the hydraulic action of the water. By an arrangement of channels the water is admitted to the underside of the weir so that, at a predetermined water level, the water pressure underneath the weir will raise it to position again. These weirs are also arranged so that they can be manipulated by hand by means of a sluice gate. In order to prevent erosion at the toe of the weir, it is provided with a wooden apron of special design. The toe of the weir is curved inward and the apron is put a little below it and a short distance in advance of it, thus making a gap between the weir and the apron under the curved toe of the weir. The water pouring down over this gap creates a partial vacuum in the gap and under the wooden apron, which tends to draw in the water at the lower side of the apron and causes silt and gravel to settle at this point, instead of being scoured away.

Water from the reservoir passes through an intake gate 23 ft. wide into an open canal 512 ft. long, at the end of which it passes into sand settling basins of a type patented by a Swiss engineer named Buchi, which are notable on account of their small size and efficient operation. After passing through the settling basins the water enters a non-pressure conduit nearly seven miles long. Over six miles of this conduit are in tunnel and the remainder is in side-hill canals or aqueducts. The side-hill canals are covered over to prevent soil being washed into the stream.

FIG. 2—START OF THE OPEN CANAL WORK

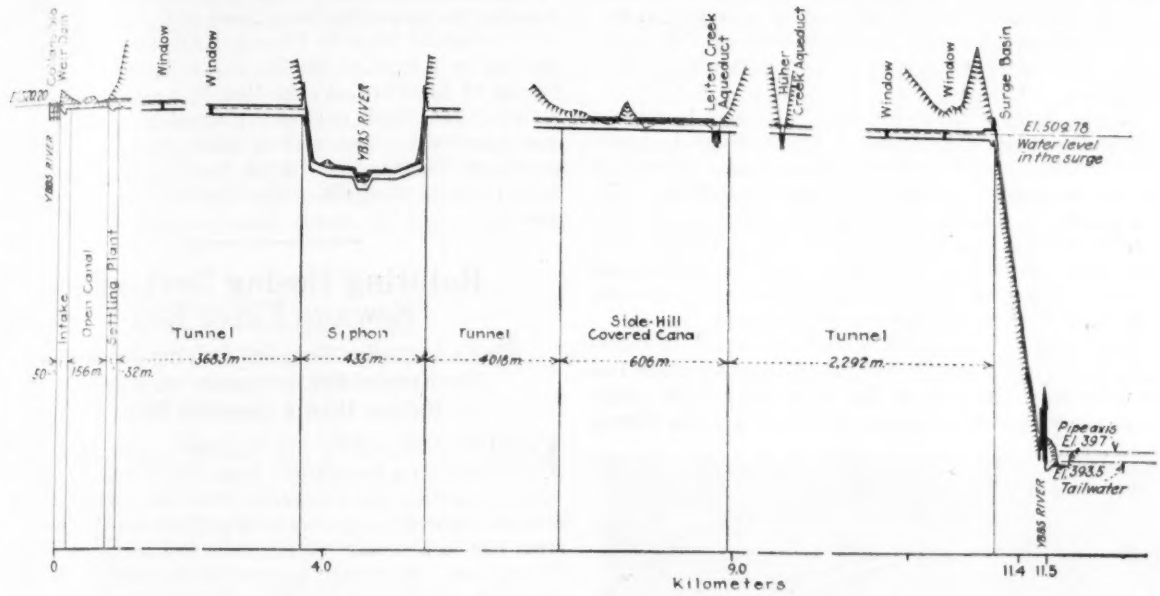


FIG. 3—CONDENSED PROFILE FROM DAM TO POWER HOUSE

Tunnels and Aqueducts—The first tunnel is 2.2 miles long and being close to the side of the valley is worked from both portals and four adits. The lower end of this tunnel, where it comes out into the river valley, is 82 ft. above the river bottom. Here a siphon 1,384 ft. long carries the water under the river, railroad and highway to the other side of the valley where it enters a second tunnel, called the *Frieslingtunnel*, 2.4 miles long. This tunnel passes under Mt. Friesling and consequently is worked only from the portals. From the Friesling tunnel the water passes into a side-hill canal, which is carried over Leiten Creek by an aqueduct 78 ft. long, then into a third tunnel which is intersected at one point by a deep canal cut requiring an aqueduct, and then continues in tunnel to the surge basin. The two aqueducts are made by using ordinary viaduct structures on which the aqueduct, a rectangular concrete box, is carried. The aqueduct is separated from the supporting structure by a layer of insulating material and is provided with expansion joints closed with copper stops.

Tunnel Construction—With the exception of the south end of the Friesling tunnel no solid rock was encountered, despite the predictions of the geologists. Consequently although the cross-section area of the conduit was only 64.5 sq.ft., the average daily progress amounted to only 13 ft., and the maximum daily progress to 21 ft. Eleven pounds of dynamite were needed for each foot of heading. Where solid rock was found, the bottom heading was driven first, but where unsound rock was found the upper heading was driven first and then excavated to the full section in blocks from 20 to 26 ft. long. The tunnels are lined throughout with concrete, the surface of which is made very smooth, so that in calculating the cross-section area of the tunnel a coefficient of roughness of $n = 0.013$ of the Ganguillet-Kutter formula could be used. The lining is made at least 8 in. thick, and special care was taken with it in the section of the tunnel through gypsum rock, on account of the destructive effect of gypsum rock on concrete. Water in the tunnel, which amounted to as much as 20 gal. a second, was handled by electric pumps and ventilation was effected by electrically driven high pressure ventilators.

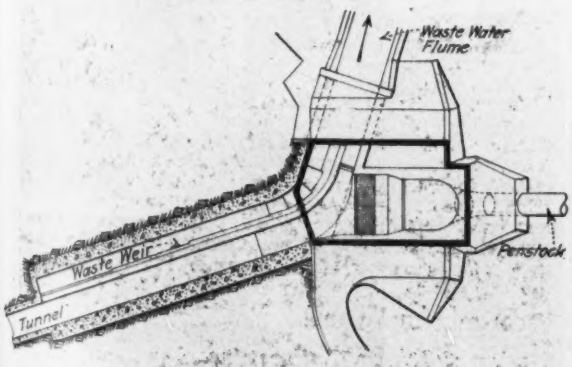


FIG. 4—PLAN OF THE SURGE BASIN
Showing the method of widening the tunnel to permit the use of a longitudinal wier.

Surge Basin—The surge basin at this installation does not need a large storage capacity because the variations in the demand on the plant are carried by the steam plant at Vienna. Consequently it is equipped with only the necessary screens and valves and with a waste weir 112 ft. long. To save masonry, the tunnel section was enlarged sufficiently to make it possible to construct the waste weir lengthwise of the tunnel, where it approached the surge basin, the waste water being carried at one side of the enlarged tunnel to a discharge channel beyond the upper end of the penstock. The sluice gate at the upper end of the penstock is automatically controlled by means of a pneumatic long-distance control situated in the power house. It can also be controlled electrically from the power house.

Penstock—The penstock consists of one single pipe 780 ft. long, varying in diameter from 7.2 to 5.9 ft. It is provided with one expansion joint at the upper end and with sliding saddles to diminish friction. It is sup-

ported throughout its length on concrete block at 26-ft. centers and has its lower end set in a large concrete block, arranged to take the entire load of 700 metric tons, which is transmitted to it on account of the sliding bearings.

At the lower end the penstock is turned through a horizontal angle into the power house where it serves three Francis spiral turbines, which at an efficiency of 80 per cent have a maximum output of 12,300 hp. The generators are direct-connected to the wheels and have a total rated output of 50,000 hp. Each turbine uses 141 cu.ft. per second and makes 600 revolutions per minute. Electrical energy is generated at 5,000 volts and stepped up to 110,000 for transmission.

Transmission Line—The electrical current is transmitted to Vienna over a 110,000-volt transmission line 84 miles long. It goes as far as Gresten as a simple three-phase long distance line, and from there to Vienna

FIG. 5—INTERIOR OF THE LINED TUNNEL
Showing the enlarged section for the surge basin.

as a double three-phase long distance line on steel towers. The average span between towers is 676 ft., but varies from this to as high as 1,300 ft.; where the line crosses the Danube River the span is 1,246 ft. On the simple three-phase line, the conductors consist of three aluminum covered steel wire ropes, having a sectional area of 0.05 sq.in. of steel and 0.208 sq.in. of aluminum. This is the first time that a combined aluminum and steel wire rope has been used for this purpose in Austria. At the Danube crossing the conductors will be silicon-bronze wire of a sectional area of 0.15 sq.in. The standard poles are 68 ft. high, but at the Danube crossing they will have to be 150 ft. high in order to provide a clear height of 65 ft. over the river at times of high water.

Organization—The WAG, which is constructing this plant, was organized by Dr. M. Pernt, the former chief of the construction department of the Bureau of Electrification of the Austrian Federal Railways, who is now chief engineer and general manager of the WAG. The construction work is being done by several contracting firms on a cost-plus basis, the percentage averaging between 17 and 22 per cent. The 22 per cent covers the cost of rented equipment and depreciation, and also the interest on the money which the contractor has to borrow to finance his work. The Francis turbines were made by the S. M. Voith Co. of St. Polten, Austria, a branch of the famous firm of Heidenheim, Germany.

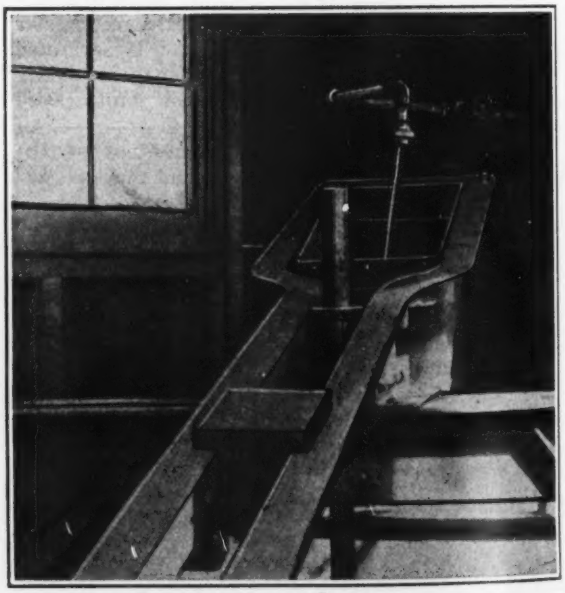
The WAG has other projects in view, one of which includes the reconstruction of part of the second Vienna water conduits between Lunz and Kienberg. This plan will utilize a head of 656 ft., and will have an average output of 5,000 hp. At the time this conduit was constructed the chief engineer planned to develop this water power, but met with so much objection from the people of Vienna, who feared that it would interfere with the quality of the water, that the idea was abandoned.

Rotating Dosing Device for Sewage Filter Bed

Ship's Propeller Supplies Driving Force for Mechanism Set to Operate on a Time Rather than a Quantity Basis

PENDLETON, ORE., has installed gravel filter beds for clarifying the effluent from a sedimentation tank designed for the city's sewage. Four beds, each with an area of about 0.4 acre, are used and the flow is diverted from bed to bed successively, each bed being dosed for 30 minutes. As nearly as may be expected in the absence of sprinkling nozzles, which may be supplied later, the beds are sprinkling filters. A very limited head was available and it was found that four alternating siphons to change the flow from bed to bed would cost a total of $1,800 in addition to the cost of a rather shallow dosing tank. A substitute was designed in the form of a rotating dosing device which was built locally and which is here described. The cost of the device itself was about $140 and the foundations, housing and accessories cost about $100 more.

The effluent from the tank, having a maximum rate of flow of 1½ m.g.d., reaches the dosing device in a 2x2½-ft. wooden trough from which it passes downward through a circular opening and outward through a spout to one of the four distributing troughs. The spout is supported by a vertical shaft in such a manner that it rotates from one to another of these distributing troughs. The sewage in dropping through this spout



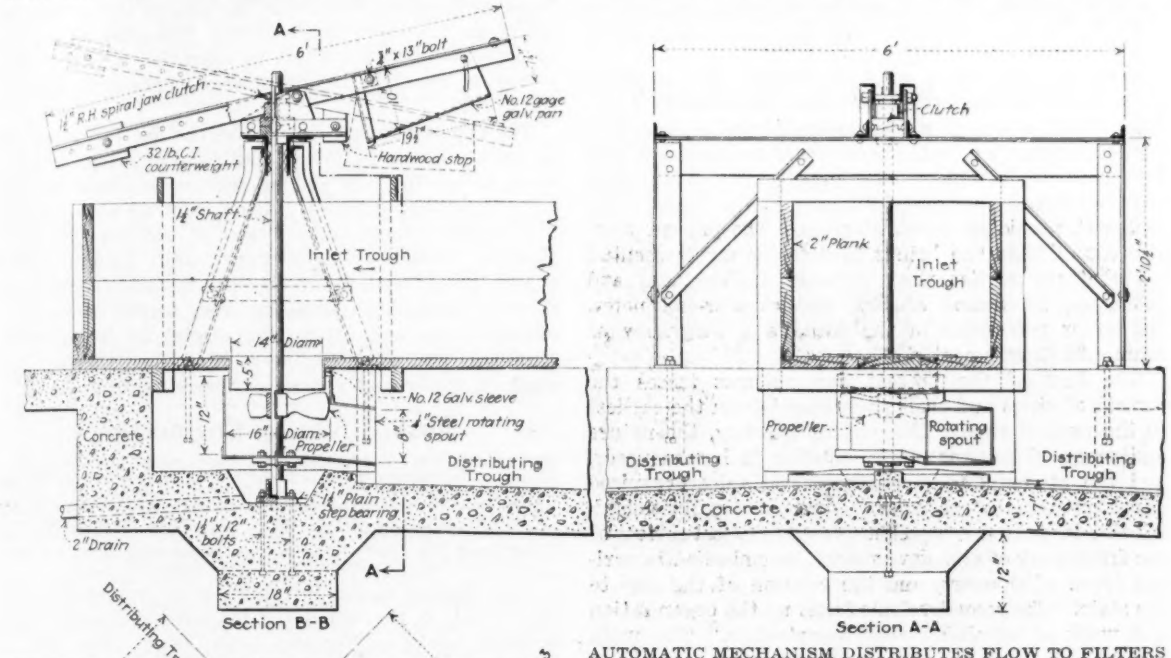
WALKING BEAM AND STREAM FLOWING INTO PAN

comes in contact with a ship's propeller mounted on the same vertical shaft, with the effect that a continuous torque is exerted.

The spout is prevented from rotating continuously by a spiral jaw clutch at its upper end. This jaw clutch is released at the proper intervals by a walking beam device which resembles in a general way the well known "tilting bucket" rain gage. The walking beam has a counterweight on one end and on the other a pan or scoop into which a small stream of water flows continuously through a flush tank regulator. The size of the stream is carefully regulated so that the pan fills and overbalances the counterweight at the desired time interval.

When the pan fills and tilts the walking beam, a bumper takes the impact and dumps the contents of the pan into the sewage trough, after which the counterweight returns the beam to its original position. Meantime the jaw clutch, released by the tilted beam, has allowed the pressure of the water passing over the propeller to turn the spout through 90 deg. where it is locked in position until the clutch is released again when the pan has filled. Before the device was put in operation it was feared that the pan might not return quickly enough and that the jaw clutch would skip one or more teeth. For that reason a number of adjustments were provided in the counterweight and pan. However, the device was found to be not at all sensitive to these adjustments and the bucket returns very promptly after discharging.

Although the device operates on a time rather than a quantity schedule, this was not objectionable in this case because, even under peak-flow conditions, a 30-minute period does not overtax the filter beds.



AUTOMATIC MECHANISM DISTRIBUTES FLOW TO FILTERS

Inlet and distributing troughs are of wood, the only concrete construction used being in the foundation. The device is housed in a small frame structure that is kept locked, an attendant visiting the plant only occasionally to oil the mechanism, and make any necessary adjustments. The plant has been in operation about a year without having developed any operating troubles that the attendant could not quickly remedy.

The only improvement which the designers could suggest after experience with the plant is that a more efficient rotating device would be desirable if it could be employed without too much additional cost. If ball bearings were used and a highly efficient rotating device were employed the head loss might be kept down to less than one foot.

The device was designed by Baar & Cunningham, consulting engineers, Portland, Oregon.

Curious Explosion Wrecks House

An explosion, concerning the cause of which no definite information is known, completely wrecked the interior and damaged the walls of a completed but untenanted three-story house in Ottawa, Can., recently. The probable cause seems to have been a four-hour accumulation of hard-coal gas burning in the furnace of the house to supply heat enough to dry the newly-plastered walls. It is believed the dampers were closed, preventing natural escape of the smoke.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Survey of Municipal Government

MUNICIPAL GOVERNMENT AND ADMINISTRATION: VOL. I. GOVERNMENT; VOL. II. ADMINISTRATION—By William Bennett Munro, Ph.D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 459 and 517. $3 per volume.

With a background of two decades of classroom work and three books on municipal government Prof. Munro has produced a two-volume work of nearly a thousand pages which for some years to come will hold first rank in its field. The three earlier books dealt with European and American government respectively and with municipal administration. The present treatise consolidates and brings to date the more essential parts of the earlier three volumes and includes and continues, by means of foot and chapter-end notes, the major references in the author's Bibliography of Municipal Government.

The first of the present two volumes traces the growth of cities and their government from the earliest to the present time. The why of the city, the nature and range of its problems in relation to human needs, and the attempts to meet those needs by organized effort through the centuries are presented and criticised. All this leads to a comprehensive and critical review of the framework of city government, as embodied in various types of charters, and the relation of the city to the state. The second volume takes up the organization and work of administrative departments. The main topics, each treated in two to five chapters, are: The Administrative Mechanism, City Planning and Public Works, Public Safety, Public Health and Social Welfare, Public Utilities and Municipal Finance.

Pains are taken throughout to present the pros and cons of such controversial matters as state control contrasted with home rule; the advantages and disadvantages of the mayor-and-council, the commission and the commission-manager plans, and the first of these three combined with more or less independent administrative boards; the relative merits of boards and single commissioners; municipal and private ownership of natural monopolies and many other subjects on which there are differences of opinion.

In the volume on Administration Prof. Munro goes into considerable descriptive detail of paving, water supply, sewerage, water and sewage treatment, garbage disposal and street lighting. This has entailed a vast amount of laborious compilation and condensation and at the same time has subjected the author to the risks attendant on one-man cyclopedic work in these days of technical complexity. By his own broad study, his choice of authorities and the criticism of many colleagues and counsellors at Harvard and elsewhere, Prof. Munro has kept to a commendable minimum the misleading exposition of scientific principles and the errors in working detail to which his extensive program made him liable. Little real harm will be done by such slips, not very frequent, as that the largest activated-sludge plant in the world is at Manchester, England, and the largest in this country at Milwaukee. When Prof. Munro's statement was written the smallest of two activated sludge plants that had been in use for several years at Houston, Tex., was the largest of the kind in actual use anywhere in the world. When the Milwaukee plant is completed and put in operation it will be, for a time at least, the largest sewage-works of its kind in the world.

The apparently few errors like the one just cited can be readily corrected in the additional printings which a work so meritorious and of such wide appeal as this one should soon demand. Aside from its wide possible use in the schools and colleges of the country, Prof. Munro's Municipal Government and Administration might be read with profit—both to themselves and those they are pledged to serve—by every mayor, councilman, commissioner and other city official in the country. Municipal and other engineers would find the first and much of the second volume of interest and profit.

Rural Highway Engineering

RURAL HIGHWAY PAVEMENTS, Maintenance and Reconstruction: A Discussion of General Principles Illustrated by Current and Recommended Practice—By Wilson G. Harger, C.E., Engineer New York State Department of Highways; Former Senior Highway Engineer, U. S. Office of Roads; Author, Highway Engineer's Handbook, etc. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 637; more than 200 half-tones and line cuts, including folding maps. $6.

Much highly useful information is presented rather discursively in this volume of the author's contemplated series of books on highway engineering. The manner of presentation has its appeal to the general reader but also it lengthens the book. It may be questioned too whether the added length due to extensive quotation of recent specifications and to the lengthy tabulation of records, which might be summarized, are justified. Close editing is a service which the author owes to his reader in these days of mounting costs of book manufacturing. With so much that is useful in the book a curtailment might well have been made of much which it contains that is ephemeral or a matter of general knowledge.

The subtitle of maintenance and reconstruction hardly defines the scope of the volume. Its contents include general planning, pavement design and type selection, and materials and tests as well as the section specifically on maintenance and reconstruction. Substantially the book is a general manual on road planning, design, construction and maintenance, stressing construction and structure. Altogether it is a book of specific data rather than a discussion of principles, except in the first chapter on general administrative considerations and in the second chapter on general pavement design and selection of types. Illustrations, and particularly drawings of pavement structure, are a useful feature and it is a rather notable fact that the author has kept up closer with current practice than is commonly the case in treatises on the rapidly progressing art of rural road pavement design. The author's announcement that "this volume contains basic data ordinarily used in the design, construction, maintenance and reconstruction of rural highways" is well borne out.

Sabin's House Painting Revised

HOUSE PAINTING, GLAZING, PAPER HANGING AND WHITEWASHING: A Book for the Household—By Alvah Horton Sabin, M.S., D.Sc., M. Am. Chem. Soc., M. Am. Soc. T. M., etc. Third Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. 160. $1.50 net.

In these days of high prices, when every householder puts off as long as possible even minor house repairs and postpones repainting the whole exterior of his house in the hopes of a legacy or some other windfall, Dr. Sabin's handy and eminently practical manual on house painting and related work is more valuable than ever. Dr. Sabin, who is well known to many waterworks, structural and testing engineers, has a happy way of making available to the uninitiated the fruits of his long years of research and its practical applications on paints, varnishes and japans. The first edition of House Painting was favorably noticed in *Engineering News*, Sept. 17, 1908, p. 320. In the present edition, the author states in his Preface, "a few rather unimportant changes have been made," and some new matter "to guide the amateur who wishes to mix his own paint" has been added.

A British "Primer" on Town Planning

TOWN PLANNING AND TOWN DEVELOPMENT—By S. D. Adshead, M.A., F.R.I.B.A., Professor of Town Planning, London University, Past President of the Town Planning Institute. New York: E. P. Dutton & Co. London: Methuen & Co. Cloth; 6 x 9 in.; pp. 204; 16 plates and 18 diagrams. $5. 10s. in England.

Professor Adshead is well known in England, and among specialists in America, for both his teaching and practice of town planning and housing. His present aim is to produce a textbook or "primer" concerned only with "the social, economic and administrative aspects" of town planning. Moreover, the volume is designed to be the first of a series of books in this field. With these limitations in mind and an understanding of the fact that the volume is addressed primarily to students and problems in Great Britain the book may be pronounced satisfactory.

The first chapter deals with the sociological basis of town planning, or the human approach. Next the interrelationship of towns, areas of utilization and town extension are considered. There follow chapters on transport, traffic requirements and roads, road administration, zoning and town planning by private initiative. Under the last-named head industrial and garden villages and cities are considered. After chapters on municipal housing and the various early and later housing acts the author takes up in considerable detail the British town planning acts of 1909 and 1919 and procedure thereunder. A brief chapter on continental and American town planning concludes the volume.

For American students, in and out of school, the most useful parts of the book are the earlier chapters on the sociological and intra-town aspects of the subject, the details of the 1909 and 1919 town planning acts, especially as regards amended procedure after some years of experience, and the sketch of Continental town planning legislation. The page on American town planning might better have been omitted, since it gives very little information and states "there is no Town Planning Act in America, but the different towns have powers," etc., without explaining either that (1) under the American Constitution the federal government has no control over cities or (2) that there is a large body of town planning and zoning legislation, emanating from many of the five-score state legislatures which alone have jurisdiction over municipalities. Perhaps a worse fault, for a British book, is the lack of any mention whatever of town planning in Canada.

The illustrations, particularly the halftone plates, are well chosen and handsomely engraved. The typography, presswork and paper accord with the best of books printed in England, as this book was, although for a 200-p. book it seems a pity that the volume must be so bulky and costly in these days of crowded bookshelves and overtaxed purses. It is only fair to add that a considerable part of the cost this side of the water is due to the tariff.

Low-Grade, Powdered and Briquetted Fuels

THE UTILIZATION OF LOW-GRADE AND WASTE FUELS—By W. Francis Goodrich, M.B.E., Author of Pulverized Fuel, Modern Destructor Practice, Refuse Disposal and Power Production. London: Ernest Benn. Cloth; 8 x 10 in.; pp. 368; 212 line cuts and halftones. 42s. net.

PULVERIZED AND COLLOIDAL FUEL—By J. T. Dunn, D.Sc., F.I.C., Consulting Chemist, Newcastle-upon-Tyne. London: Ernest Benn. Cloth; 8 x 10 in.; pp. 197; 54 line cuts and halftones. 25s. net.

AN INVESTIGATION OF POWDERED COAL AS FUEL FOR POWER-PLANT BOILERS: Tests at Oneida Street Power Station, Milwaukee, Wis.—By Henry Kreisinger, John Blizzard, C.E., Augustine and B. J. Cross. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 92; line cuts. One copy free; 15c. from Superintendent of Documents, Washington, D. C.

PRODUCTION AND BRIQUETTING OF CARBONIZED LIGNITE—By E. J. Babcock and W. W. Odell. Work done under a co-operative agreement between the U. S. Bureau of Mines and the School of Mines of the University of North Dakota. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 82; line cuts and halftones. One copy free; 20c. from Superintendent of Documents, Washington, D. C.

Mr. Goodrich has long been known to American engineers concerned with city refuse disposal as the author of the two books on refuse destructors mentioned in the foregoing heading from the first of the books under notice. The present book contains a chapter on Town's Refuse: Its Fuel Value, which briefly reviews not only the subject indicated but also the latest types of British destructors. Although still an earnest advocate of utilizing the fuel value in city refuse Mr. Goodrich frankly says that "it is only rarely and under favorable conditions that a refuse destructor can be operated without incurring loss," but apparently he means this in a commercial sense, with no allowance for the fact that the refuse must be disposed of by some means. The better way to put the question, at least from the American viewpoint, is whether the revenue from heat utilization will reduce the cost of refuse destruction below the net cost of some other sanitary method of disposal. Mr. Goodrich also says, in effect, that the combination of refuse destructors with electricity generating stations has not fulfilled the anticipations of twenty years ago but he asserts that at more than a hundred sewage pumping stations town refuse has wholly or nearly displaced coal as fuel. What Mr. Goodrich does not bring out is the fact that many British town are screening their refuse in order to free the destructors from the heavy burden of fine ash that formerly was put through them.

Only a small part of Mr. Goodrich's book deals with city refuse as fuel. He takes up colliery wastes, lignite and brown coal, peat, coke, breeze, briquettes, wood, and miscellaneous wastes and gasification of low-grade and waste coal. He treats also of boilers, furnaces and firing, and the entire equipment and operation of boiler houses.

Mr. Dunn's Pulverized and Colloidal Fuel is devoted chiefly to the former. Like Mr. Goodrich's book, that of

Mr. Dunn is largely descriptive of various types and makes of equipment and their operation. Both take notice of American and other practice outside Great Britain.

The general character of the two Bureau of Mines bulletins is indicated by the headings printed above. The pamphlets and books together give evidence of the world-wide attention that is being given to low-grade fuels in these times of high prices.

PUBLICATIONS RECEIVED

THE FLORIDA ENGINEERING SOCIETY has started the publication of a monthly bulletin entitled *The Florida Engineer and Contractor* (J. R. Benton, secretary, Gainesville, Fla.).

OUTDOOR SWIMMING POOLS, a paper by Stanley Pinel, occupies the 30 pp. of the January Bulletin of the Engineering Extension Department of Iowa State College, Ames, Iowa. Plans and detailed drawings as well as halftones are reproduced.

THE FIRST MONOGRAPH in a projected "Economic Series" has been issued by the Committee on Plan of New York and Its Environs (130 East 22nd St., New York City). The monograph is entitled The Chemical Industry in New York and Its Environs: Present Trends and Probable Future Developments, and was prepared by Mable Newcomer, Ph.D., associate professor of economics, Vassar College. Among other things, the monograph shows that the larger chemical plants are seeking for cheaper land and that as a result of this and other economic forces it is predicted in the monograph that "the chemical industry will continue to move from the center toward the periphery of the region, the heavy branches tending strongly toward the West rather than toward the East." Thomas R. Adams is general director of plans and surveys.

TWO REPRINTS FROM *Public Health Reports* that will appeal to sanitary engineers are No. 839, Distribution of Malaria in the United States as Indicated by Mortality Reports, by Kenneth F. Maxcy, assistant surgeon, U.S.P.H.S., and No. 844, The Principles Underlying the Movement of Bacillus Coli in Ground-Water, with Resulting Pollution of Wells, by C. W. Stiles, professor of Zoology, Hygienic Laboratory, and Harry R. Crohurst, sanitary engineer, U. S. Public Health Service.

MEMORANDA AND TABLES entitled Further Notes on the Sale of Water for Irrigation at Volumetric Rates constitute Paper 27 of the Punjab Irrigation Branch (Lahore, India). Among the contributors to the pamphlet are F. J. Waller, Lala Ram Rakha, W. G. Dench and C. A. Colyer and E. S. Crump, executive engineers, and P. B. Varma, superintending engineer.. Most of the data would require recomputation to be significant to American irrigation engineers but the report, like others in the series, shows that much careful study is being given to irrigation matters in the Punjab.

HOW TO START SEWERS OR SEWAGE-WORKS from the viewpoint of the citizen or public official is told in *Special Bulletin 43* of the California State Board of Health, and Planning and Maintaining Sewers Systems and Sewage Disposal, by C. H. Gillespie and two members of his engineering staff. The bulletin might be characterized as first aid to the town and city officials who want to do the right thing by their community but find the problem of selecting the right engineer and making important and far-reaching decisions entirely outside of their usual experience. Organizing and financing works, brief digests of pertinent laws and succinct advice on how to carry a bond issue are given. Methods of disposal are noted with examples.

STANDARDS FOR ELECTRIC SERVICE has been put out in a second edition by the Bureau of Standards. It contains a summary of all the rules now in force in 22 states and in addition a complete set of rules suitable for adoption by state public utility commissioners. Ordinances suitable for different sized cities are proposed, together with a survey of present regulations by city ordinances. (Superintendent of Documents, Washington, D. C.; 60c.)

HUNDREDS OF ANALYSES OF COAL are given in a Bureau of Mines bulletin, Analyses of Samples of Delivered Coal Collected from July 1, 1915, to Jan. 1, 1922, with a Chapter on the Tidewater Pool Classification, by Ned H. Snyder (one copy free from Bureau of Mines or 15c. from Superintendent of Documents, Washington, D. C.).

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

DIE ELEKTROSTAHLÖFEN: Ihr Aufbau und gegenwärtiger Stand sowie Erfahrungen und Betriebsergebnisse der elektrischen Stahlerzeugung; Praktisches Hand- und Nachschlagebuch für den Stahlfachmann—Von E. Fr. Russ. Oberingenieur. Munich and Berlin: Printed and published by R. Oldenbourg. Paper; 7 x 10 in.; pp. 471; 503 halftones, line cuts and plates.

EISENBRÜCKENBAU: Dritter Band. Die Hauptträgersysteme Nebst Ihrer Berechnung Bauliche Einzelheiten der Balken-, Bogen- und Hängebogenbrücken Bauliche Einzelheiten der Hangerbrucken Herstellung der Eisenbrücken in der Werkstatt und auf der Baustelle—Von George Cristophe Mehrtens, Geh. Hofrat und Professor der Ingenieur Wissenschaften an der Technischen Hochschule, Dresden. Leipzig: Wilhelm Engelmann. Paper; 7 x 10 in.; pp. 435; halftones and line cuts.

With increasing tendency toward uniformity in steel bridge construction, the information on practice abroad which is contained in foreign bridge treatises becomes increasingly valuable as a stimulus to the designer. The posthumous volume of Mehrtens' three-volume work on steel bridge construction is one of the best from this viewpoint. It presents an interesting selection of bridge designs, and its critical comments are expressive of experienced judgment. The major part of this volume is devoted to join. details of truss bridges, arches and suspension bridges.

ELEMENTARY HYDRAULICS—By F. W. Medaugh, Instructor in Civil Engineering, the Johns Hopkins University. New York: D. Van Nostrand Co. Cloth; 6 x 8 in.; pp. 144; one folding diagram plate and 71 text illustrations, mostly line cuts. $2.

ELEMENTS OF WATER BACTERIOLOGY with Special Reference to Sanitary Water Analysis—By Samuel Cate Prescott, Professor of Industrial Microbiology in the Massachusetts Institute of Technology, and Charles-Edward Amory Winslow, Professor of Health in the Yale School of Medicine. Fourth Edition, Rewritten. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in., pp. 211. $2.25. 11s.

Pending a more extended notice it may be said that this standard work has been extensively revised to cover changes incident to the developments of the eleven years since the appearance of the fourth edition. The valuable bibliography has been extended to June, 1923.

FOIBLES AND FALLACIES OF SCIENCE: An Account of Celebrated Scientific Vagaries—By Daniel W. Hering, C.E., Ph.D., LL.D., Professor Emeritus of Physics and formerly Dean of the Faculty of the Graduate School in New York University. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 294; line cuts and halftones. $2.50 net.

HANDBUCH DES MATERIALPRÜFUNGSWESENS für Maschinen- und Bauingenieure. Von Dipl.-Ing. Otto Wawrziniok, ord. Professor an der Technischen Hochschule, Dresden. Zweite vermehrte und vollständig ungearbeitete Auflage. Berlin: Julius Springer. Cloth; 6 x 9 in.; pp. 700; 641 line cuts and halftones. $5 in Germany.

Nominally a second edition, this is in large degree a new work. Compared with American treatises on testing the book presents many novel features, among them the inclusion of a good section on micrography and microstructure, a chapter on workshop tests of quality (such as flanging, drifting and bending tests), and a chapter on investigation of defective material, written on the case-study principle.

HOUSING PROGRESS IN WESTERN EUROPE—By Edith Elmer Wood, M.A., Ph.D., author of The Housing of the Unskilled Wage Earner. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 218; halftones and line cuts. $3.

LEAD THE PRECIOUS METAL—By Orlando C. Harn. New York and London: The Century Co. Cloth; 6 x 9 in.; pp. 323; many line cuts and halftones. $3.

The story of lead from the mine to its many uses in the arts and sciences, presented, the author states in his Introduction, "with a commingling of practical information and romantic sidelights to capture and hold those good folk who like facts well enough but prefer them to be not too dreamy and long-faced."

LEHREN DER EXPLOSIONS KATASTROPHE IN OPPAU FÜR DAS BAUWESEN—Von Dipl.-Ing. H. Goebel und Dr.-Ing. E. Probst. Berlin: Julius Springer. Paper; 9 x 12 in.; pp. 41; halftones and line cuts.

An article based on this pamphlet appeared in *Engineering News-Record*, Jan. 10, p. 66.

UNTERBAU—Von W. Hoyer, Professor an der Technischen Hochschule, Hannover. Berlin: Julius Springer. Boards; 7 x 10 in.; pp. 185; 162 illustrations, mostly line cuts. $1.95 in Germany.

Interesting mainly because of the unusual grouping of subjects and the very compact treatment, this book has an unusual title, the equivalent perhaps of "Substructures." The subjects are earth and rock excavation, railway earthwork and wall construction, culverts and siphons, and finally tunnels and tunneling. The treatment is practical and unusually effective, and it covers the four subjects noted in less than 200 pages.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Square Reinforcing Rods Have Bond Superiority

Sir—This letter really constitutes a plea for the square reinforcing bar. When the World War put such a severe strain on the steel industry, the companies rolling reinforcing bars decided to reduce the number of sizes to be rolled and in doing so eliminated all square bars except the ½-, 1- and 1¼-in. squares. It seems that these companies have decided to perpetuate this elimination and have continued the practice of rolling round rods in preference to square bars.

While rounds lend themselves to just as efficient and economical design for tension or compression the question of bond is quite another matter. The reinforcing bar companies would habitually substitute for ¾-in. squares, ⅞-in. rounds in requisitions for reinforcing steel. A comparison of areas and circumferences shows that the ⅞-in. round with a sectional area of 0.6013 sq.in. has a circumferential area of 2.7489 sq.in. per inch of length, or a ratio of bounding area to moment area of 4.57 to 1.0. On the other hand the ¾-in. square bar has an area of 0.5625 sq.in., a perimeter providing an area of 3 sq.in., per inch of length and a ratio 5⅓ to 1.0, so that it is about ten per cent more efficient in bond per bar than the approximately equivalent rounds and over 16 per cent per unit area. The figures comparing a ⅞-in. square bar with its present substitute, the 1-in. round, illustrate the same condition.

While bond stresses are not usually a deciding feature in the selection of reinforcement for simple beams, etc., they are frequently a deciding factor in doubly reinforced beams and girders especially where continuous over several supports and also in footings for foundations. Where the loads are of medium weight, ½-in. square bars are available, but above that the use of the round bars results in uneconomical conditions requiring additional steel for bond.

Hoboken, N. J., M. HIRSCHTHAL.
March 15, 1924.

Laitance Dangerous in Under-Water Concrete

Sir—Referring to the article on page 460 of your issue of March 13 describing the breaking of the foundation block of concrete in the Lewis & Clark bridge, it is just possible that the primary trouble was due to laitance, which is not only very permeable to water but also has no more tensile strength than chalk. I have put in a good deal of concrete under water and in several cases have been able to examine it later, and I have found that even with the best of care the laitance is very liable to collect between the different batches during the pouring, especially if there is a delay of say 10 or 15 minutes before the next batch covers up the last one. It is this laitance which causes the seam-seepages occasionally noticed on the lower sides of high concrete dams, and if it can occur in such structures which are given all possible care it must evidently be much more difficult to prevent or remedy it in concrete laid under water. In the case of the bridge in question there may have been more laitance in the plane of failure than elsewhere, and any weakness would have been aggravated by the rocking of the waves to which Mr. McCullough refers.

Incidentally, I have found it very difficult to get inspectors to appreciate the fact that laitance is not surplus mortar, and that it may be a source of serious trouble later if it is not scraped off or spaded into the mass so as to leave no weak and permeable seam. I once examined a retaining wall sustaining a 14-ft. head of water, and, though supposedly it had had competent inspection, each day's work was separated from its neighbors by a layer of laitance from ⅛ to 1 in. thick. The wall was standing, but frost had eaten into the layers for a depth of nearly 2 in. in four years.

Mr. McCullough has adopted the only real safeguard available against trouble from laitance seams, viz., that of embedding plenty of reinforcing rods.

New York, Mar. 15, 1924. D. A. W.

Logarithmic Equation for Friction Losses in Pipes

Sir—The criticism by Mr. Moritz (*Engineering News-Record*, Feb. 28, p. 374) of my article in your issue of Oct. 11, 1923, entitled, "New Logarithmic Equation for Friction Losses in Pipes," was evidently inspired by the belief that the article in question had to do with an entirely new form of equation as applied to pipe flow. There was no intention on my part to put forth any such claim.

The proposed formula does, however, deal with constants that have never before been published and in that sense it is new. Mr. Moritz proves the point by citing a number of formulas that are quite different. The common type of logarithmic formula, $h_f = cd^m v^n$, has been replaced by $h_f = Av^n$ and a table of values of the coefficient A has been submitted in which the values of A were computed from a large amount of experimental data.

A number of formulas for frictional losses in pipes are based upon limited premises—in many cases isolated series of tests. As previously stated, the constants referred to in my article were calculated from a great number of experiments and seemed to me, therefore, to be worthy of publication. I still maintain that formulas containing variable coefficients are much in evidence and that they are in many cases inferior to those in the logarithmic form.

I am glad to assure Mr. Moritz that our departmental files contain extensive references to the flow of water in pipes. Incidentally, the need for more light on the subject is plainly indicated by such articles as "The Frictional Coefficient of Concrete Surfaces in Pipes and Channels," by E. Parry, *Engineering*, Vol. CXIV; and, "Similarity of Motion in Relation to the Surface Friction of Fluids," by T. E. Stanton and J. R. Pannell, Nat. Phys. Lab., Coll. Researches, Vol. XI.

F. W. GREVE,
Associate Professor of Hydraulic Engineering,
Lafayette, Ind., Purdue University.
March 10, 1924.

Non-Technical Direction and the Gleno Dam Failure

Sir—The findings of the committee charged with the investigation of the failure of the Gleno Dam in Italy (*Engineering News-Record*, Jan. 31, 1924), will be watched with much interest by engineers the world over. However, in view of the unsuitable materials and construction methods employed there would appear to be little doubt as to the main causes of the disaster.

The writer is informed that during the whole duration of the construction work, no responsible engineer or contractor was employed on the job, that many of the laborers were women, and that apparently even the most elementary rules of good construction were violated. The dam was built by day-labor and without any engineering supervision during the time of the bolshevik political disturbances in Italy after the war. The fact that a portion of the masonry of the gravity base was laid up in lime mortar, and that subsequently some of this masonry was squeezed out, is a further indication of where the real source of the trouble was.

From a preliminary investigation made by responsible engineers, it appears that neither the type of dam nor the quality of the bed-rock is responsible for the failure, but solely the poor materials used and the inadequate methods of construction. Both the gravity section and the multiple-arch dam were of conservative design. For instance, the buttresses were 6 ft. 3 in. thick at the crest and 11 ft. 6 in. thick at the base, 90 ft. below the crest; they were spaced 30 ft. on centers. The Gem Lake Dam in California has about the same height of 90 ft. as the multiple-arch structure of the Gleno Dam, but its buttresses are spaced 40 ft. on centers and are about 2 ft. thick at the crest and 4.5 ft. thick at the 90-ft. depth. The buttresses of the Gleno Dam were therefore two or three times as thick as the buttresses of the Gem Lake Dam, which latter has proved sufficiently strong. At the time of the failure the water level in the Gleno reservoir stood fully 8 ft. below the crest of the

dam. The unit stresses in arches and buttresses must therefore have been very low, and only extremely poor concrete, or trouble in the lime mortar of the gravity base can have been the cause of the failure.

It is further of importance to note that only those buttresses and arches of the Gleno Dam went out which were built on top of the gravity base. On both wings of the dam, where the buttresses were founded on rock, they remained in place.

The responsibility for the disaster lies evidently with the owner, who, although he was not an engineer, had all the work done under his and his foremen's direction. The failure of the dam was apparently due to a violation of the most elementary rules of construction. It would, therefore, be regrettable if the progress made by Italian engineers during recent years in dam engineering, should be jeopardized through the ignorance and criminal negligence of a non-technical man, who through unusual circumstances was allowed to build this dam in defiance of fundamental laws of construction. On the other hand, the thorough investigation of the Italian commission of experts, whose personnel is of the highest standing, will no doubt furnish much information which could not have been obtained in any other way, and thus be of great benefit for future dam constructions.

FRED A. NOETZLI,
Secretary, Committee on Arch Dam Investigation.

Los Angeles, Calif.,
March 3, 1924.

Runoff Near Continental Divide: Corrections

Sir—Robert Follansbee has called attention to a serious error in my table of yield of Rocky Mountain drainage basins (*Engineering News-Record*, Feb. 28, 1924, p. 357). The data of yield there given were derived from Mr. Follansbee's Water Supply Paper No. 500 where they appear in the form of acre-feet per square mile. In converting these into second-feet the conversion ratio,

$$\text{second-feet : acre-feet per day} = 1 : 2,$$

was inadvertently used as a multiplier instead of a divisor. As a result the values of runoff in c.s.m. and inches in the column headed "Average Yield" of Table I and the corresponding figures in the text and on the map should all be divided by 4.

Even this drastic correction does not change any of the main conclusions of the paper. The measured runoff still is in some instances larger than the measured precipitation corrected for elevation, and in all cases but one the corrected precipitation is inadequate to account for the measured yield plus a reasonable allowance for water losses. Corrected figures of yield appear in the subjoined table,

CORRECTED YIELD COLORADO MOUNTAIN DRAINAGE BASINS

No.	Stream	Average Yield (Corrected)		Yield Plus Water Losses	Precipitation Corrected for El.	Yield Not Accounted for	Per Cent of Measured Yield	
		C. S. M.	Inches	Inches	Inches	Inches	$100\frac{(7)}{(4)}$	
(1)	(2)	(3)	(4)	(5)	(6)	(5)-(6) (7)	(8)	Slope (9)
1	Uncompahgre at Ouray	1.88	25.5	40.4	33.0	7.4	29	W
2	Uncompahgre below Ouray	2.31	31.4	46.3	32.4	13.9	44	W
3	Canyon Creek at Ouray	2.46	33.4	48.3	30.4	17.9	54	W
4	Rio Grande at Thirty Mile Br	1.51	20.5	35.4	25.6	9.8	48	E
5	Crystal River at Marble	3.23	43.9	58.8	31.3	27.5	63	W
6	Maroon Creek near Aspen	2.10	28.6	43.5	31.3	12.2	43	W
7	Castle Creek near Aspen	1.71	23.3	38.2	34.1	4.1	18	W
8	Roaring Fork at Aspen	1.77	24.0	38.9	30.5	8.4	35	W
9	Frying Pan Creek at Thomasville	1.51	20.5	35.4	28.9	6.5	32	W
10	Homestake Creek at Redcliff	1.67	22.7	37.6	32.4	5.2	23	W
11	Turkey Creek at Redcliff	1.30	17.7	32.6	27.3	5.3	30	W
12	Tennessee Fork near Leadville	.862	11.7	26.6	22.9	3.7	32	E
13	East Fork Arkansas near Leadville	.822	11.2	26.1	24.4	1.7	15	E
14	Halfmoon Creek near Leadville	1.21	16.5	31.4	23.6	7.8	47	E
15	Chalk Creek near St. Elmo	1.06	14.4	29.3	24.2	5.1	35	E
16	Snake River at Dillon	1.09	14.8	29.7	34.4			W
17	Ten Mile Creek at Dillon	1.36	18.5	33.4	32.5	0.9	5	W
18	Fraser River near Arrow	1.93	26.2	41.1	37.0	4.1	15	W
19	Geneva Creek at Grant	.993	13.5	28.4	23.7	4.7	35	E
20	N. Fork South Platte at Grant	.650	8.8	23.7	21.3	2.4	27	E
21	South Boulder Creek at Rollinsville	1.63	22.1	37.0	20.8	16.2	73	E

columns 3 and 4. Column 5 shows the corrected yield in inches plus an allowance of 14.9 in. for water losses as determined at Wagonwheel Gap. The yield unaccounted for in inches is shown in column 7. This ranges from zero to 27.5 in. and averages about 35 per cent of the measured yield.

It is true that the water losses vary somewhat on the different areas but the probable variation therein is much too small to account for the differences; furthermore, it is somewhat doubtful if the precipitation increases with elevation up to the summit of the divide, as was assumed in preparing Fig. 2, from which the correction for elevation has been obtained, so there are still large differences to be accounted for from some other source than measured precipitation and yield. In other words, Fig. 2 is likely to represent more than the true precipitation as it would be measured by rain gages actually located on the higher portions of these drainage basins, and, if so, the unexplained differences between measured precipitation and runoff are larger than shown in the table.

Professor R. L. Sackett has called attention to the omission of a cosine factor from the denominator in the derivation of the formula for roof effect (p. 358). The corrected formula should read:

$$\frac{\text{Catch}}{\text{Measured precipitation}} = \frac{\cos\,(r-s)}{\cos r \cos s}$$

Referring to Fig. 4, the amount of precipitation actually caught on ad is to the measured amount as $ac : ab$ (not $ab : ac$).

ROBERT E. HORTON,
Consulting Hydraulic Engineer.

Voorheesville, N. Y.
March 11, 1923.

Norway Builds Turbines for Use in Canada

Sir—In *Engineering News-Record*, Dec. 13, 1923, is an article regarding a large contract for turbines awarded to Armstrong Whitworth & Co., England, by the Newfoundland Power & Pulp Co.

As England has very little water power, it must be surprising to your readers to see that an English firm is able to secure an order of this kind on the American continent, where the design and construction of hydraulic turbines are so highly developed.

The solution of the problem is, that the turbines are designed by Norwegian engineers, Armstrong Whitworth & Co. having an agreement with a well-known turbine firm in Kristiania, by which this firm is supplying all drawings and specifications for turbines made by the company.

Norway's developed water power amounts to about 1.5 million hp. and some of the large turbines have been made in Switzerland and Germany, but that is a thing of the past. Turbines of any size and for any head are now made in this country.

Y. B. NAUMANN.

Kristiania, Norway,
Jan. 22, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Municipal Preference in Boulder Canyon Opposed

Colorado River Bill Objected To By Southern California Edison Company Executive

Washington Correspondence

Testifying last week before the House committee on Irrigation of Arid Lands on the Swing-Johnson bill for the construction of a dam across the Colorado River at Boulder Canyon, R. H. Ballard, vice-president and general manager of the Southern California Edison Co., strongly opposed the feature of the bill which would give a preferential position to municipalities in taking power from the Colorado and took an attitude hostile to municipal electric service generally. He also suggested that his company would be willing to undertake the entire Colorado River development "If for any reason it is found inexpedient for the government to make this appropriation, we are prepared to do the whole job." The company is ready to spend from $30,000,000 to $40,000,000 per year.

On the other hand, if special privileges are given to the municipalities with respect to Colorado River power, Mr. Ballard suggested that his company would have to prepare for retiring from the field and would not extend its service as required by the needs of the territory which it serves. He estimated that it would take ten years before municipal power could be obtained from Boulder Canyon, while, on the other hand, he claimed that his company could develop power from the Colorado River within two years.

Power Available

Referring to the necessity for developing power in small steps, in harmony with the growth of a market for the power, he said that Arizona cannot be relied upon as a market for Boulder Canyon power because Diamond Creek will be developed as soon as the bars are down on the Colorado. He estimated that more than 3,000,000 hp. can be developed on the Colorado from Lees Ferry to the Gulf without touching the Grand Canyon. Under the plans of his company the first development would be for 300,000 hp. at Topock; the second step would be the construction of a large reservoir at Glen Canyon, with 300 ft. initial height; subsequent development would be at points between the two sites. He also said that power can be transmitted in large amounts up to a distance of 1,000 miles, economically.

The Topock dam, first to be built, could be constructed in two years at a cost of $2,500,000. He also denied the claim that Los Angeles needs to get water supply for increased population from the Colorado River, and claimed that a population of 10,000,000 people in the Los Angeles district can be supplied from the present source and others nearby without the Colorado.

Finally, Mr. Ballard stated the position of his company thus: "The company is not opposed to the construction by the government of the dam on the Colorado River at whatever point the government desires for the purpose of flood control and also, if the government so desires, for the purpose of power development. The company would object to the representatives of the people of the United States saddling upon the public an unwise development. We are opposed to the Swing-Johnson bill as now written, calling for the appropriation of $70,000,000 for the erection by the government of a dam at Boulder Canyon and particularly the provision of that bill which gives to political subdivisions an undue and unwarranted preference. We think the government should not go into the power business, nor should the government tie itself to a proposition of special legislation which is contrary to the law of the United States under which many developments have been made because such special legislation would deteriorate or would be unfair to those people who have made those developments."

Ithaca Seeks City Engineer

The Board of Public Works of Itacha, N. Y., will receive written applications until April 15 for the position of city engineer. Satisfactory candidates are to be invited to appear before the board. Applicants should submit statements showing age, educational qualifications and training, professional experience and a list of references. Full particulars are to be found in the Searchlight section of this issue.

Montclair Takes Over Water-Works

After a long agitation and much controversy over changing from private to public ownership of local water-works, the town of Montclair on March 10 took over the privately-owned distribution system, shut off the filtered supply drawn from the Passaic River at Little Falls and turned down an unfiltered but chlorinated water from the Pequannock supply main of the city of Newark. The town will pay Newark $20 a million gallons for Pequannock water until the completion of the Wanaque development that is being carried out by the North Jersey District Water Supply Commission for Newark, Montclair, and other municipalities. When the Wanaque supply is completed, Montclair will continue to take Pequannock water from Newark, giving Wanaque water to Newark in exchange.

Philadelphia Reorganizes Its Transit Commission

The councilmanic transit commission of Philadelphia, originally organized in 1923 by resolution of the city council, has been reorganized under the present administration by the passage by council of a resolution practically identical with the one adopted last year. The commission developed the comprehensive plans for city transit on which the subways of the city are now being provided for.

The commission is composed of ten members of city council, the mayor, the city solicitor, and representatives of the Chamber of Commerce, the Philadelphia Real Estate Board, the Operative Builders' Association, the Builders' Exchange and Employers' Association, the United Business Mens' Association, and Manufacturers' Club. The latter body never appointed a representative to the place to which it is entitled. The representatives of the other bodies are the same as on the previous commission, except that Alba B. Johnson represents the Chamber of Commerce in place of Col. William B. Barba.

City Planning Excursion Trip and Conference in April

An excursion trip for members and guests of the City Planning Conference to be held in Los Angeles April 7-10 has been arranged for. The eastern group will leave New York City March 29, at 8:45 a.m., traveling over the Pennsylvania R.R. Stops will be made as follows: Monday in Memphis, Tuesday in New Orleans, Wednesday afternoon and evening in Houston, Saturday in San Diego. The final portion of the trip, from San Diego to Los Angeles, will be made by motor Sunday morning. Further details of the excursion with program of the conference may be obtained from Flavel Shurtleff, secretary, 130 East 22nd St., New York City.

Among the speakers at the conference will be C. J. Colden, of Los Angeles, on "Harbor Terminals and Their Approaches," to be followed by M. M. O'Shaughnessy, city engineer of San Francisco, and E. P. Goodrich, consulting engineer, New York City; Harland Bartholomew, city planning consultant, St. Louis, Mo., on "Street Widening Methods with Particular Reference to Distributing the Cost"; Charles W. Leavitt, consulting engineer and city planner, New York City, "Street Widening for Bridge Approaches"; A. C. Godward, Minneapolis, "The Use of Building Lines in Street Widening; and Frederick L. Olmsted, Brookline, Mass., "Distribution of Metropolitan Parks."

There will be zoning table discussions at 8:00, 12:45 and 6:30 whenever no other event is scheduled for those hours.

A.R.E.A. Annual Meeting Draws Record Attendance

University Co-operation and Economic Subjects Supplement Discussions on Design and Practice

Accounting as a subject upon which engineers and every member of the American Railway Engineering Association should be well informed, both as to principle and practice, was a strong point emphasized in the presidential address delivered at the twenty-fifth annual convention of the Association at Chicago, March 11 to 13, by E. H. Lee, vice-president and chief engineer of the Chicago & Western Indiana R.R. He specially urged upon the young engineer and railroad man the importance of this subject. In spite of unfavorable conditions, some of which must be expected to continue, the railroads are giving the public better service than ever before, and as a result of steps which are being taken to bring the public to a realization of this fact, public sentiment has become more favorable to the Transportation Act. Mr. Lee considers that every member of the Association should act as a publicity man in influencing public opinion favorably towards the railroads.

Human Side Presented

The human side of the engineer's work was dealt with from two angles during the course of the meeting. The report of the new committee on Co-operation with Universities outlined the mutual advantages to students, colleges, railroads and the Association by such co-operation as to secure adequate educational methods and a realization by railroad officers of the advantages of employing men of technical training. The necessities and advantages of taking steps to secure and retain competent workmen and foremen formed the main subject of the report of the committee on Economics of Railway Labor. Reports of twenty-four committees aggregating about 1,200 pages, were printed in advance, and one report was presented in typewritten form. Since every report was considered and acted upon, the amount of discussion was relatively small, few subjects receiving real constructive consideration. This is becoming the normal experience at the conventions and seems to call for attention on the part of the officers of the association.

An unusually large attendance featured this meeting, the registration totaling 785 members and 202 guests as compared with 665 and 168 at the 1923 meeting. A membership of 2,149, with a gain of 139, was shown in the report of the secretary. Two prominent features of the association's work, brought out in this report, are: (1) Co-operation with other organizations in matters of mutual interest and (2) extensive research in practice and economics. The financial conditions are favorable, although the heavy expenditure for the latest edition of the "Manual of Recommended Practice" caused the expenditures to exceed the receipts by $3,799. The receipts totaled $47,873 and ordinary expenditures $40,757, but extraordinary expenses (on account of the "Manual") increased this to $51,678.

Ray Heads Railway Engineers

George J. Ray, elected president of the American Railway Engineering Association at last week's annual convention in Chicago, was born at Metamora, Ill., and graduated from the University of Illinois in 1898. The same year he entered the service of the Illinois Central R.R., and served in various capacities in the engineering department until 1903, when he went to the Delaware, Lackawanna & Western R.R. as division engineer at Scranton, Pa. In 1909 he was appointed chief engineer of the road, which position he has held continuously since that date except for the time that he was on leave of absence to act as engineering assistant to the regional director of United States Railway Administration.

A great deal of Mr. Ray's time has been devoted to the interest of the American Railway Engineering Association. He served as a member of the track committee from 1910 to 1917, being chairman in 1916 and 1917; as member of the rail committee from 1917 to 1923, being chairman from 1918 to 1922; as a member of the stresses in track committee from 1915 to 1923; and as a member of the committees on standardization and of co-operative relations with the universities since their organization in 1920 and in 1923. He served as a director from 1914 to 1916, inclusive, was elected second vice-president in 1922 and first vice-president in 1923.

Mr. Ray was elected a member of the American Society of Civil Engineers in 1908, and in 1915 received the honorary degree of Doctor of Science from Lafayette College.

New President of American Railway Engineering Association

George J. Ray

Officers for the year 1924-1925 are as follows: President, G. J. Ray, chief engineer, Delaware, Lackawanna & Western R.R.; vice-presidents, J. M. R. Fairbairn, chief engineer, Canadian Pacific Ry., and C. F. W. Felt, chief engineer, Atchison, Topeka & Santa Fe Ry., the former continuing his term and the latter being newly elected. The treasurer is George H. Bremner and the secretary, E. H. Fritch, both re-elected.

Staten Island-New Jersey Crossing Study Made

Feasibility and Value of Bridge or Tunnel Reported Upon by Interstate Commission

Study of the feasibility and value of a bridge or tunnel connection between the southern end of Staten Island and the New Jersey mainland (Tottenville to Perth Amboy) was recently made by the Joint Bridge and Tunnel Commissions of New York and New Jersey, Clifford M. Holland, chief engineer. The location in question is one of the principal vehicle crossings from New York City to the central and southern parts of New Jersey, and is now served only by ferry. From 1914 to 1923 the ferry traffic has grown from 89,000 vehicles and 930,000 passengers to 354,000 vehicles and 2,000,000 passengers per year.

Expected Traffic

It is estimated that by 1928, the earliest time by which a bridge or tunnel could be completed, the traffic will have grown to 800,000 vehicles per year (including part of the traffic of two other ferries, assumed to be diverted to the new crossing). These figures warrant the construction of a better means of crossing, as the congestion at the ferry approaches on days of heavy traffic is now very serious, lines of waiting vehicles often extending more than a mile back from the ferry house.

Navigation requirements in Arthur Kill, the channel separating Staten Island from the New Jersey mainland, require an unobstructed channel at least 750 ft. wide, with an overhead clearance of 135 ft. above high water. As there is high ground on either side of the waterway a high-level bridge is readily constructed, and the subsurface conditions are favorable to either bridge or tunnel construction.

Bridge Crossing Favored

On the basis of these data, Mr. Holland has reported in favor of a bridge crossing located immediately north of Perth Amboy and Tottenville and making direct connection with the main highways in New Jersey. The project design for estimate purposes is a cantilever bridge with main span 750 ft. c. to c.; total length (including viaduct approaches) 8,250 ft. A 40-ft. roadway to accommodate four lines of traffic would be provided. The approach grade would be 4 per cent or less. This structure would have a capacity sufficient to take care of 15,000,000 vehicles per year, which is far beyond the requirements of the immediate future.

Estimates of cost indicate that the total, including real estate, would be $5,000,000. Assuming that this bridge was completed in 1928, with an initial traffic of 821,000 vehicles per year, and with an average toll of 50c. per vehicle (ferry rates for automobiles and vans range from 30 to 78c.), it is found that the bridge would be paid for in ten years from the date of opening and at the end of the eleventh year there would be a surplus sufficient to cover the annual maintenance and operation charges without collection of any tolls from traffic.

Permanent Immigration Law Doubtful This Session

House To Consider Johnson Bill, But Amendments Seem Certain—Senate Action Still Far Away

Washington Correspondence

After extensive hearings covering two years, with the committees of the House and Senate widely at variance on important features of permanent immigration legislation and with many individual plans being put forward by non-committee members of Congress, considerable doubt is expressed in Washington regarding passage of a bill before the 3-per cent quota law expires June 30. Unless there is a speedy agreement on permanent immigration legislation Congress will probably adopt a resolution extending the present temporary law for another twelve months.

The House committee has favorably reported the Johnson bill, which fixes immigration by quotas of 2 per cent based on the census of 1890, with certain exemptions which would make the permissible net influx of aliens somewhat larger than would be indicated by an inflexible application of the percentage but would overcome objections to the present temporary law because of separation of families. The Johnson bill provides examination of aliens before embarkation for the United States, and is selective by mental, physical and other tests of fitness. The Senate committee, however, has proceeded by a majority vote on a bill to admit 2 per cent quotas based on the census of 1910. Its plan differs from the House bill also in exemptions and numerous other points.

PROVISIONS OF JOHNSON BILL

Under the Johnson bill, based upon the 1890 census, western European countries would gain proportionately in the number of nationals admissible to the United States, while southern and eastern Europe would lose. Under the plan favored by the Senate committee, the ratio would swing in favor of southern and eastern Europe.

Both committees within the last week have held hearings on the objections of certain foreign nations, notably Japan, to proposed exclusion clauses of the permanent legislation, representations on this point having been made by the State Department. Apparently, the exclusion provisions will be so drafted as to give no offense to friendly governments while retaining the exclusion idea.

When the House considers the Johnson bill an effort will be made on the floor to amend it. The amendment which apparently has the greatest strength among the non-committee bills appears to be the Aswell bill which would superimpose upon the Johnson bill a system of selection by occupational needs of the United States. Thus, if there were a shortage of carpenters shown by the monthly state labor reports, carpenters would be given preference by consuls above others in filling the quotas.

Early action on immigration legislation is expected in the House, but Senate action is not yet within sight.

N. Y. Opposes Lake Diversion

In accordance with a message of Governor Smith transmitted to the New York State Legislature on March 17 inviting attention to a communication addressed to the executive by Dwight B. La Du, state engineer and surveyor, the Assembly Tuesday passed a resolution memorializing Congress to defeat H. R. No. 5475 (Hull Bill) and H. R. 7044 (Madden Bill) both of which, among other things, provide for a diversion of 10,000 sec.-ft. of water from Lake Michigan.

A similar bill is expected to pass the State Senate within a few days.

Cincinnati Studies Improvements

To promote development of the city of Cincinnati, Ohio, along civic, industrial and commercial lines, the Chamber of Commerce has organized a committee of survey to consider a variety of subjects including the following: (1) Freight and passenger terminals; (2) natural and industrial resources; (3) expansion of industries; (4) local and rapid transit transportation; (5) rail, water and road transportation; (6) changes in city charter; (7) city revenues and Ohio tax revision. This program is expected to extend over three years. James M. Hutton is chairman of the committee.

New Reclamation Bill Proposed

A bill contemplating further reclamation development was laid before Congress by Secretary Work of the Department of the Interior during the past week. It provides that before any new irrigation project is undertaken or an existing one extended, the Department shall obtain detailed reports on construction, cost, land prices and development costs, and through the Department of Agriculture and the Department of Commerce shall obtain information on climate, soil, and crop production, and upon transportation facilities and markets. The bill is officially stated to be designed "to encourage the undertaking of new and feasible reclamation projects under conditions which will as nearly as possible secure their success."

Clifford F. MacEvoy Awarded Contract for Wanaque Dam

Clifford F. MacEvoy & Co., of Newark, N. J., has been awarded the contract for the construction of the main dam, gatehouses, overflow weir and incidental construction of the Wanaque Dam for the North Jersey District Water Supply Commission. The winning bid was for a total of $3,318,990, four other contractors submitting bids, as follows: Phillipsburg Construction Co., Yonkers, N. Y., $3,377,135.78; W. H. Gahagan, Inc., Brooklyn, $3,398,279.70; W. F. Carey Co., 25 Broad St., New York City, $3,398,279.70; Frederick Snare Corp., New York, $3,475,933.61. The foundation and lower portion of the dam are being constructed under a separate contract.

John G. D. Mack

Biographical Sketch of the Late State Engineer of Wisconsin, Who Died February 24

John G. D. Mack, former state engineer of Wisconsin and professor of engineering at the University of Wisconsin, whose death was noted in these columns recently, was born at Terre Haute, Ind, in 1867. He was graduated in mechanical engineering from Rose Polytechnic Institute in 1887, and pursued graduate study at Cornell, receiving the mechanical engineering degree therefrom in 1888.

After five years of engineering practice, Mr. Mack went to the University of Wisconsin as instructor in machine design. His rise at that institution was rapid, and in 1899 he was made head of the department. When the Wisconsin legislature, in 1915, created the position of state chief engineer, Professor Mack was selected to fill the position. His achievement at the capitol is summarized thus by F. E. Turneaure, dean of the college of mechanics and engineering of the University of Wisconsin:

"To capable men he gave the utmost encouragement and credit, and made no attempt to direct where direction was not needed. He was immensely in earnest in having things done right in every sense of the word. By his fine tact and good judgment, he succeeded in establishing a state engineering department of such scope and efficiency as is hardly equalled elsewhere in the country."

While in university work Professor Mack had rendered valuable service to the State Railroad Commission as an expert in the mechanical division, and under his direction was made the first valuation of rolling stock and other equipment of the railroads of the state.

Mr. Mack was very active in community and professional affairs, being a member of the Kiwanis Club, Masons, American Society of Mechanical Engineers, Technical Club of Madison, University Club and the honorary fraternities of Tau Beta Pi, Sigma Xi and Phi Rho Sigma.

Contractor Sued on Fraud Charge

A $7,000,000 suit charging misuse of government funds has been filed against Smith, Hauser & McIsaac, Inc., New York contractors. The case, which was filed in Baltimore by the United States District Attorney for Maryland, follows alleged excess charges in the construction of Camp Meade, Md. One of the first alleged fraud cases to be filed against war camp builders, that against Stone & Webster, was recently quashed in the Supreme Court for the District of Columbia, when the defendant was upheld in his contention that no specific charges were made in the indictment. More than half a dozen other cases are pending.

Coolidge Names Commission to Study St. Lawrence

Hoover Heads U. S. Body—Canada Agrees to More Engineers on Joint Engineering Board

Pursuant to correspondence with the Canadian Government regarding the Great Lakes-St. Lawrence waterway and power project, President Coolidge last week announced the personnel of the St. Lawrence Commission of the United States, a body which will consider the whole project in its economic and national aspect and form an opinion as to whether the project should be undertaken at the present time. At the same time word was given out by the State Department that the Dominion Government had agreed to the suggestion of the United States Government that two additional engineers be appointed by each government on the Joint Engineering Board.

The St. Lawrence Commission of the United States is as follows: Herbert Hoover, chairman; William C. Breed, New York City, attorney, and former president of the New York Merchants Association; James E. Davidson, Bay City, Mich., vice-president, American Ship Building Co., Bay City; James P. Goodrich, Winchester Ind., formerly Governor of Indiana; James R. Howard, Chicago, Ill., formerly president of the American Farm Bureau Federation; James D. Noonan, American Federation of Labor; Stephen B. Davis, Washington, D. C., counsel; and Charles P. Craig, Duluth, Minn., executive secretary. A ninth member is to be named from New England.

Coolidge Addresses Hoover

In making announcement of the personnel of the commission, President Coolidge said:

"It is my desire that the commission should thoroughly consider the whole project and be able to express an opinion as to whether or not the project should be undertaken at the present time. If this judgment should be in the affirmative, then I wish the commission to consider the formulation of such projects as might be submitted for international agreement on construction, finance and administration—all of which, of course, must be of a preliminary nature as a basis for formal negotiations with the Canadian Government, and obviously subject to the views of Congress."

In order that the investigations of the commission may be co-ordinated with those of the Joint Engineering Board, the War Department has been requested to place at the disposal of Secretary Hoover engineering officers.

In its note to the United States, the Dominion Government suggests that the non-technical commission of the Canadian Government, which will work in connection with the Joint Engineering Board (now enlarged to six members, three from each government), be purely advisory. Canada also accepts the suggestion of the United States that the two commissions report first upon the practicability of the project as outlined by the Joint Engineering Board preliminary report of June, 1921, and also as to whether any revisions in estimated costs are necessary. The conclusions reached by the International Joint Commission were that the physical conditions were favorable and that the total cost from Montreal to Lake Ontario is estimated at $252,728,200, including the cost of developing 1,464,000 hp. of hydro-electric energy.

Engineers and Surveyors of New Jersey Organize

One hundred and seventy licensed professional engineers and land surveyors, meeting in Trenton, March 18, organized the New Jersey Society of Professional Engineers and Land Surveyors. This action was consequent upon the repeated expression during the past year of the desirability of such an organization, and a letter canvass in which 358 men expressed themselves in favor of forming such a society. Its membership is limited to licensed engineers and surveyors. The expressed objects of the organization are the advancement of engineering knowledge and practice, the maintenance of high professional standards, the promotion of the welfare of the engineers and surveyors of the state, co-operation with local organizations of engineers, and the exercise of influence in properly solving public engineering problems.

The officers for the first year are: President, Ross P. McClave, Hackensack; vice-presidents, Fred C. Carstarphen, Trenton, and Peter F. Daley, North Bergen; secretary-treasurer, Hugh A. Kelly, Jersey City; directors, Thomas J. Wasser, Jersey City, Harvey Snook, Newton, John C. Remington, Jr., Camden, Robert O. Bentley, Newark, Claire E. Tilton, Phillipsburg, William G. Sloan, Nutley, H. C. Van Emburg, Plainfield, James S. Sparks, Salem, George D. Cooper, Red Bank, John M. Braly, Spring Lake, and George H. Noble, Clinton.

At the dinner preceding the meeting, there were addresses by Edward H. Rockwell, dean of engineering, Rutgers College, Mr. McClave, Mr. Carstarphen, Mr. Kelly and Mr. Wasser, who presented the plan of organization. E. J. Mehren, vice-president of the McGraw-Hill Co., was toastmaster.

Random Lines

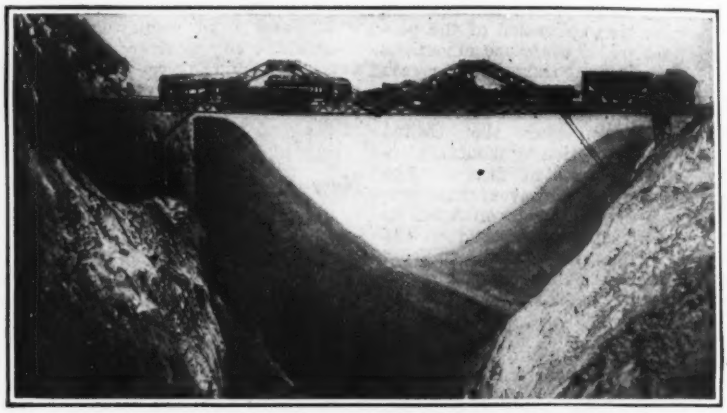
Well! A Man Must Live

Comes now one Jack McCarthy. There are a flock of Jack McCarthys in the world, but this Jack gets his mail at the Biltmore and in his day was quite a ball player and, too, an umpire, until failing eyesight caused him to take up civil engineering—From the baseball columns of a Los Angeles newspaper.

* * *

Cinematic Engineering

Sir—Some months ago you published in this column a defence of the "moving picture engineer" by "one of them." The accompanying cut from a recent film shows how excellently they do their work. According to the press agent this "is a clever bit of trick photography used in a moving picture studio. The railroad track is suspended from two plaster of paris mountains, four feet high; the cars are toys and the bridge is made with a child's building set. This is how the wreck appeared to the audience."



AS THEY BUILD THEM IN THE MOVIES

There is much that is new to engineers in the picture—for example, the use of tension members as support for the truss reactions. The skyhooks to support the junction of simple spans have apparently been omitted, but then the best of us make our mistakes.

C. A. P.

* * *

Population (1920) 6,418

ATHENS, O., March 11.—The city council has decided to employ a regular engineer to take charge of the municipal work and especially to get the city plats into permanent shape. For some years the only city records of water and sewer lines have been carried in the heads of two veteran employees and if they quit or die the city will be unable to find any mains.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Sixteenth Conference, Los Angeles, Calif., April 7-10, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Atlanta, Ga., April 9-12, 1924.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

The Southeastern Water and Light Association will hold its first annual convention at Atlanta, Ga., April 15 to 17. W. F. Stieglitz, Columbia, S. C., is secretary-treasurer of the association.

The Associated Engineering Societies of St. Louis has submitted the names of the following engineers to the Citizens Bonds Issue Supervisory Committee as competent to pass on city engineers' plans for projects under the $87,000,000 bond issue: Baxter L. Brown, Terrell Croft, Edward B. Fay, Edward Flad, John Lichter, E. L. Ohle, Erle Ormsby, R. C. Siefert, C. E. Smith, Walter L. Upson and George E. Wells.

Personal Notes

HAROLD R. DEAN, Poughkeepsie, N. Y., announces the opening of an office in the Dale Bldg. in that city, for general engineering practice in water supply, sewerage systems and municipal works. Mr. Dean was until recently chief engineer with George D. Campbell, Poughkeepsie.

S. B. THAYER SON & Co., engineers and financiers, Washington, D. C., announce their removal March 1 from the Munsey Bldg. to larger quarters at 308-316 Bond Building in that city.

FRED A. NOETZLI, consulting engineer, has opened an office at 927 Central Bldg., Los Angeles, Calif., for practice in dam construction and storage investigations. As secretary of the Committee on Arch Dam Investigations, of the American Society of Civil Engineers, Mr. Noetzli is engaged in research work relative to dams and is working on the designs and the program of tests of the proposed experimental dam which may be constructed this year under the supervision of this committee.

F. C. YOUNGBLUTT, appraiser of the Omaha Federal Land Bank since 1922, has been appointed project manager of the Belle Fourche project, in South Dakota, of the U. S. Bureau of Reclamation. Mr. Youngblutt was graduated from the University of Wisconsin in 1906 and was in the U. S. Reclamation Service from 1906 to 1922.

F. G. TEGTMEIER, former engineer of Snohomish County, Wash., and past president, State Association of County Engineers, has become associated with the Puget Sound & Alaska Powder Co., of Seattle, with his headquarters in Everett, Wash. Mr. Tegtmeier has been engaged for the last 15 years in general engineering and construction work in Everett.

L. G. KRAUSE, engineer in charge of the railroad section of the Bureau of Engineering of the Public Service Commission of Pennsylvania, has been appointed assistant chief engineer of the bureau, succeeding H. E. EHLERS, who has been made director of city transit in the city of Philadelphia.

F. E. HOUCK, formerly secretary and treasurer of the Fred R. Jones Co., Chicago, is now associated in the same capacity with the new company of Hamer-Paskins-Houck Co., contractors, Chicago. D. E. HAMER, formerly general superintendent of the Jones company, and J. C. PASKINS, superintendent for Greene & Sons for a number of years, the other members of the firm, are president and vice-president. The new company will follow railroad construction work principally.

GEORGE C. DIEHL, civil engineer, Buffalo, N. Y., has opened a branch office at 2912 Delaware Ave., Kenmore, N. Y., for consulting practice in highway, sewer, water and drainage engineering in western New York.

H. H. NUNN has resigned as manager of the Contractors' Association of Northern California to accept the position of city manager of Santa Barbara, Calif. Prior to taking up his work with the Contractors' Association last June Mr. Nunn was for eight years engaged in highway engineering in Oregon, first as chief engineer of Multnomah County and later as state highway engineer.

JOHN L. HARPER, vice-president and chief engineer of the Niagara Falls Power Co., and H. BIRCHARD TAYLOR, vice-president of the William Cramp & Sons Ship & Engine Building Co., and a director in the Dominion Engineering Works, announce the formation of HARPER & TAYLOR, INC., with offices in the Bankers Trust Bldg., Philadelphia, Pa., and at 1445 Buffalo Ave., Niagara Falls, N. Y., for the conduct of a general engineering business, paying particular attention to the design, construction and operation of hydroelectric projects. Mr. Taylor will be president and general manager; formerly he was hydraulic engineer of the I. P. Morris Co. which is now a department of the Cramp company: and later became president of the Pelton Water Wheel Co. Mr. Harper will be vice-president and chief engineer, and will continue his present work with the Niagara Falls Power Co. H. P. RUST will be mechanical engineer and in charge of the Philadelphia office: NORMAN R. GIBSON will be hydraulic engineer and in charge of the Buffalo office. OLIVER D. DALES and LOUIS S. BERNSTEIN will be engineers in charge of construction and design, respectively.

CAPT. J. D. FAUNTLEROY, for the past two years state highway engineer of Texas, resigned, effective March 4, and will return to the U. S. Bureau of Public Roads, Washington, D. C., with which he was formerly connected as district engineer for Texas, Oklahoma, Louisiana and Arkansas.

W. W. PATCH, division engineer for the California State Highway Commission, with headquarters in Los Angeles, has resigned to engage in private practice. Mr. Patch had been with the commission for the past nine years.

CRAIG BRADFORD has been appointed superintendent of Denver's mountain parks, relieving City Engineer Vickery who will devote his entire time to city engineering work. Associated with Mr. Bradford will be FRED C. STEINHAUER, president of the Colorado Society of Engineers and engineer in charge of work for the Olinger Improvement Co.

Obituary

JAMES ALEXANDER, of the James Alexander Construction Co., Memphis, Tenn., died in that city March 4, from paralysis, aged 65 years. Mr. Alexander was a native of Scotland. The company has erected many of the notable structures of Memphis and also executed large contracts on buildings in St. Louis and Chicago.

SIR WILLIAM DUFF REID, builder of the Newfoundland Ry., and former president of the Reid Newfoundland Co., died recently at his Montreal residence. He was 56 years old.

FRANK C. WARING, civil engineer and architect, Holyoke, Mass., dropped dead in New Haven, Conn., March 8, at the age of 54. For many years Mr. Waring was superintendent of construction for the Casper Ranger Construction Co. of Holyoke, and erected many of the Mount Holyoke College buildings.

IRVIN W. BARBOUR, of Portland, Maine, assistant engineer in charge of state and federal highways in Maine, died March 3 at an Augusta hospital after an operation for appendicitis; he was 54 years old. Mr. Barbour was born in Portland and was graduated from Cornell University in 1894, thereafter spending some years in hydraulic engineering in Canada. At the time that Deering, Maine, was annexed to Portland, Mr. Barbour was street commissioner of the former city, and he became assistant commissioner of Portland. He had been assistant engineer of the state highway commission since its establishment in 1913.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Railway Appliances Shown at Chicago Exhibit

Labor-Saving Machines and Tools—Track Material—Buildings and Water Stations and Paving

Engineering News-Record Staff Report

ALTHOUGH no great developments or innovations in railway materials, tools and equipment were presented at the National Railway Appliances Exhibition, held at the Coliseum, Chicago, last week in connection with the annual convention of the American Railway Engineering Association, there were several novelties and modifications marking progress in different lines of manufacture. In floor space and number of exhibitors the display was much the same as last year.

Labor-Saving Machinery

Labor-saving machines and motor section cars were prominent features, although the former were not as numerous or conspicuous as they might have been, while the latter were so plentiful in different makes and types that they seemed to occupy an unduly large proportion of the floor space. Such cars, however, represent an important feature in the economy of railway work under present labor conditions. The labor-saving machines of the larger class included the Brown power rail loaders and unloaders operated in work-trains on main track, and the Madden "three-man" hand power crane traveling on the track and used in renewing rails; also the Jordan ditcher and spreader of the wing type and the American ditcher of the steam shovel type mounted on a flat car. These were represented by models and photographs, as was the case with such other large apparatus as weed-killing trains, power screens for cleaning ballast and the Clark and the Western air-operated dump cars. The smaller machines included electric and pneumatic tie-tampers, a track mower and weed cutter mounted on a hand car, and three types of track liners designed to enable a few men to do work requiring a large number if equipped only with ordinary crowbars or lining bars.

Track Materials and Tools

Three makes of frogs of the "flange" type were conspicuous in the extensive exhibits of switches and frogs. In this design, a rib extending above the level of the rail head engages the outer edge of the wheel rim, so that the wheel is guided through the frog by its rim instead of by its flange. These frogs were shown by the Bethlehem, the Carlisle and the Morden companies. There were also the new gearless Duro switchstand and the new Bethlehem rolled-steel frog guard rail, in which the flange is depressed in order to fit under the base of the track rail. Tools for track work were numerous and varied, but mainly represented established designs. A Buda hand jack for pulling drift bolts was among the specialties. Steel fence posts included three or four designs. For paving highway crossings there were the Headley and the Kyrock bituminous systems, while the Portland Cement Association showed views of concrete slab paving, illustrating both the methods and the equipment employed on work of this type.

Railway Buildings and Equipment

Besides numerous roof coverings and other building materials there were the Butler portable steel buildings, Bloxon-end wood flooring, Hoffman casement window, and the Kaustine and Kelly-Derby small septic tanks for stations and shops; also leadized pipe for use where ordinary pipe is subject to corrosion. Water station equipment included several exhibits of tanks and water columns, together with three or four water-treating systems by the Graver, the Pittsburgh-Des Moines and the Chicago Bridge & Iron companies. The Aluminate Sales Co. also exhibited its process of water softening in which sodium aluminate is added to the usual lime and soda ash mixtures.

Signals

Highway crossing signals were numerous, mainly of the wigwag and twin-lamp types, the latter having two lamps lighted alternately to represent the swinging of a red lamp. There were also flashing signals and daylight lamp block signals, but the semaphore signals which used to form such a striking feature in the exhibition were conspicuous only by their absence. The Miller automatic train control system had a large exhibit, while other train control apparatus was included in the exhibit of signal companies. There was also a Pyle-National turbo-generator for the locomotive equipment in connection with such apparatus. Although much concreting is done by the railroad forces the only mixer exhibited was a Jaeger portable machine.

Visitors and Officers

The attendance of visitors at the exhibition appeared to be hardly as large as usual, probably because the railway engineering convention extended over six long sessions, so that there was comparatively little time for members to give to the exhibits. At the annual meeting of the National Railway Appliances Association it was suggested that the exhibition should be kept open every evening, but it was explained that this had been tried and found unsatisfactory. At this meeting the following officers for 1924-25 were elected: President, A. J. Fiikins, Paul Dickinson Co., Chicago; vice-president, W. J. Gillingham, Hall Signal Co., Garwood, N. J.; secretary and treasurer, C. W. Kelly, Kelly-Derby Co., Chicago.

To Hold "Shirt-Sleeve" Road Show in North Carolina

Demonstration June 4-7 Will Exhibit Machinery in Action for Benefit of South American Engineers

THE first open-air demonstration of road-building methods and machinery will take place in North Carolina June 4-7. The American Road Builders' Association has accepted the invitation of the North Carolina State Highway Commission to hold such a demonstration or "shirt sleeve" road show as it has been christened by Frank Page, president of the American Road Builders' Association.

The Pan-American Highway Commission, consisting of a group of about forty leaders in the highway movement in the various countries of South and Central America, will be in North Carolina at that time. These distinguished visitors will visit the shirt-sleeve show; the American Road Builders' Association accepted the invitation of the North Carolina State Highway Commission in order that it might do its full share to assist the members of the Pan-American Highway Commission in their study of highway conditions in the United States.

Foreign Visitors Expected

Hitherto, all exhibits of road-building machinery in the United States have been held indoors where it was impossible to put the machinery actually at work. The North Carolina show, however, will offer an opportunity to members of the Pan-American Highway Commission, as well as engineers from other foreign countries who may be in the United States at that time, of inspecting the latest types of machinery in operation under ordinary working conditions. Charles M. Upham, who served this year as convention and show manager, of the American Road Builders' Association will be in charge of the shirt-sleeve show in North Carolina.

North Carolina has been selected as the scene of this open-air demonstration not only because of the fact that it extended an invitation to the American Road Builders' Association, but also because it is recognized as one of the most progressive road-building states in the United States at the present time. By reason of its location and topography the state is developing roads of varying types. For that reason it was chosen by the Highway Education Board as the state to which the distinguished visitors will be taken at the outset of their trip.

Ford Employees Total 157,000

Employment in the Ford Motor Co. organization is now at the highest point in the company's history. There are approximately 157,000 workers in Ford industries in the United States, according to recent figures. Of these, more than 24,000 work in branch assembly plants. The largest number employed in any single manufacturing unit is at the Highland Park plant at Detroit, where 68,500 men are at work At the River Rouge plant of the com pany there are nearly 42,000 workers.

Suggest Activities for A. G. C. Manufacturers' Bureau

EXPRESSIONS of opinion concerning the newly initiated affiliated bureau of equipment manufacturers of the Associated General Contractors indicate the wide range of activities suggested for the new agency. Among the suggested activties are: standardization of capacities, investigation and information of new products, coordinated material sale and sub-contracts, establishment of approved trade practices between contractors and manufacturers, compilation and publication of production statistics, development of needed products and equipment, and constructive reports on actual performance of machines.

Many of the earlier expressions of approval, received at Washington headquarters of the A. G. C. immediately after adjournment of the Chicago convention which followed the joint meeting at which the affiliated bureau was launched, have been included in a pamphlet now being given broad circulation. This pamphlet contains a statement of the purposes and aims of the bureau.

SUBDIVISIONS CONTEMPLATED

The general plans for the bureau were initiated and approved at a joint meeting held in Chicago, attended by contractors, manufacturers of construction equipment and materials (see *Engineering News-Record*, Jan. 31, p. 217). Tentatively, it is planned to establish a number of divisions within the bureau, each to deal specifically with the problems arising in or involving particular branches of activity. A tentative outline of organization includes the following branches: Concrete mixers; rope and cable; motor trucks; power shovels; crushed stone and explosives; power pumps; creosoted products.

Business Notes

F. E. LEIBY has resigned as sales manager for the General Filtration Co., Inc., Rochester, N. Y., and has accepted a position with the sales force of the Norton Co., Worcester, Mass.

FIREPROOF PRODUCTS CO., INC., New York, announces an addition to its facilities for service in the territory covered by Eastern New York State, Northern New Jersey, and Western Connecticut in the form of a plant for handling and cutting steel reinforcing bars, located at 130th St. and Willow Ave., New York City. With its new equipment the company states that it will be able to cut bars to length and make delivery in the vicinity of New York City within 48 hr. from receipt of order, giving practically a warehouse service on fireproof building material from the company's four warehouses in New York City, Long Island City, Albany, and Newark, N. J.

INTERNATIONAL HIGH SPEED STEEL CO., New York, manufacturer of crucible electric alloy tool steels and both hollow and solid rock drill steels, announces the appointment by Judge Charles F. Lynch, of the United States Court of New Jersey, of Edward Maxson, state commissioner of banking and insurance of New Jersey, as operating receiver for the plant at Rockaway, N. J. Dissension in the company created by minority stockholders and a majority of the board of directors, it is explained, led to a condition of affairs necessitating the appointment of a receiver to conserve the rights of the creditors. The business will be continued with E. Kaufman appointed by the Court as general manager of the corporation during the receivership.

Equipment and Materials

Centrifugal Principle Embodied in Concrete Mixer Design

With a drum revolving four or five times faster than that of any of the standard concrete mixers now on the market, a new machine embodying the

centrifugal principle has been designed and operated experimentally by Nathan C. Johnson, of the firm of Hool & Johnson, consulting engineers, New York. In a number of its design features the new centrifugal machine differs radically from others in general use on construction work.

The drum of the centrifugal mixer revolves at 80 r.p.m., has an internal diameter of 40 in.; a width at center of 18 in.; and gives an output of 11 cu.ft. of mixed concrete per batch. In comparison with these figures, the drum of the ordinary No. 10 mixer, which is comparable in capacity with the centrifugal machine, revolves at a speed of 15 to 20 r.p.m., has a diameter about 1 ft. greater, and a width at least 1½ ft. greater than that of the new centrifugal unit.

The use of a small drum for a comparatively large output of mixed concrete is made possible by the centrifugal principle which utilizes more than 90 per cent of the drum volume for holding the materials to be mixed, as against the utilization of about 25 per cent of the drum volume in the case of a drum which rotates at the low speeds now commonly employed. It is not possible, at this time, to explain in detail the centrifugal mixing process, except to say that the drum is not equipped with the multiple mixing blades used on other mixers. Instead, the aggregates are forced out toward the periphery of the drum by centrifugal action and are diverted along a pre-determined path at the zenith of their travel.

Ordinarily the drive will be by gears from a gasoline engine, although the machine shown in the accompanying view, which has been under test, is driven by an electric motor. The drum is supported by trunnion wheels between cast frames.

Among the advantages claimed for the centrifugal mixer by Mr. Johnson are small size combined with large output, portability, thorough and extremely rapid mixing, and a sticky, pasty consistency of the mixed batch, almost regardless of the amount of water used, within permissible limits. The scouring action during the mixing process is said to result in a good concrete, even with dirty aggregate.

This last feature, it is pointed out, makes possible a better average concrete, due to more intimate contact of cement with virgin surfaces of aggregates, and a satisfactory use of ballast coated with clay; these coatings are common, and usually result in an absorbent, spongy concrete. The centrifugal machine, Mr. Johnson states, utilizes economically even fine sands, which are assumed commonly to be unfit for use. Further, any agglomerated lumps are broken down in mixing, so that the mass throughout is an even and intimate union of minerals.

New Valve Has Pivoted Disk Operated by Link

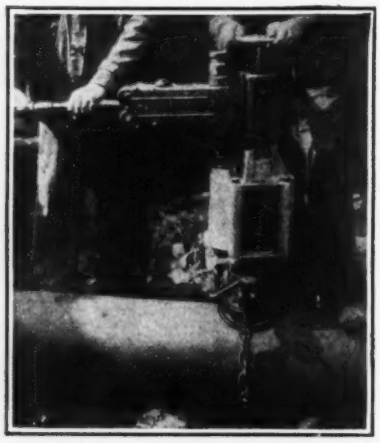
A valve of new design, originally built for superheated steam service and in use in such service in Europe for a number of years, has recently been placed on the American market by the Techno Products Corporation, 46 West 40th St., New York. It is of straight flow type, but the valve closes by motion at right angles to the seat. The valve disk is pivoted and is operated by a link engaged by the screw stem. The position of the link, moreover, is such that when closed the valve is brought to its seat by toggle action.

The shape of the valve disk contributes to protection of the seat, as a ring-shaped projection of the disk enters the central passage of the seat before the valve closes, and thereby checks the flow before the valve and its seat produce any throttling action. This fact and the provision of hard metal inserted seating rings tend to assure long life and permanent tightness. However, regrinding is made easy, as the entire mechanism may be withdrawn and the valve ground in directly on its seat; special recesses in the valve disk provide engagement for the grinding lever.

Power operation and remote control are facilitated in the design by the provision of a turned shoulder on the yoke which will receive the clamping ring of a gear bracket or motor attachment. A valve originally installed for hand operation may thus be changed to motor operation and remote control at any time.

Power Operated Machine Taps Large Holes in Pipe

To reduce the time needed to cut large-size holes in pipe by hand-operated equipment the Silent Hoist Co., Brooklyn, N. Y., has placed on the market a power tapping machine, the invention of G. H. Boyd, superintendent



of the Consolidated Gas Co. of New York. The outfit, shown in the accompanying photograph, may be driven by an air motor using an ordinary air drill on the drive shaft, by an electric motor, or by a gasoline engine through a flexible-coupling shaft. The apparatus weighs 72 lb. and is equipped with automatic feed, although it may be fed by hand for drilling if desired.

With the power tapping machine it is claimed that a 3-in. hole in cast-iron gas pipe can be drilled, reamed and tapped ready for a plug in 10 min., a 4-in. hole requiring from 15 to 18 min. On one large connection recently made by the Consolidated Gas Co. between live gas mains, Mr. Boyd reports, four 3-in. holes and seven 4-in. holes, were tapped with the power machine and two men in 3 hours.

If desired, the machine may be hand operated by applying a ratchet to the drive shaft, through a gear reduction which increases the power applied.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Value Of 1923 Federal Government Construction Greater Than Preceding Year.

Engineering News-Record statistics covering Federal Government contracts of $25,000 and over for the years 1922 and 1923 show the trend of lettings in this class of construction to be irregular. This is due, undoubtedly, to the awarding of a number of contracts at a single letting rather than one at a time. The chief feature shown by the accompanying chart is that the curves do not follow each other closely yet the general average is nearly the same. During the year 1922 there were 310 awards valued at $43,555,000 with an average value per contract of $140,500, compared with the 342 contracts totaling $47,940,000 with an average of $140,175 for 1923.

The situation according to contracts let in the geographic sections for the two years compared is summed up in the following table:

	1922		1923	
	No.	Value	No.	Value
New England	20	$2,686,900	16	$901,000
Middle Atlantic	96	16,313,278	84	10,855,000
Southern	90	8,105,589	107	12,215,000
Middle West	16	3,380,557	54	8,067,000
West of Miss.	23	4,052,730	30	6,084,000
Western	65	9,016,352	51	9,818,000
Total	310	$43,555,406	342	$47,940,000

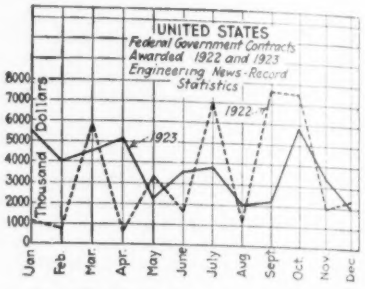
Another numerical comparison of these contracts for 1922 and 1923 shows in the following table, the trend as they advanced through the various stages of developments in the construction news section of *Engineering News-Record*:

Year	Proposed Work	Bids Desired	Bids Received	Contracts Let No.	Contracts Let Value
1923	272	483	246	342	$47,940,000
1922	262	469	154	310	43,555,406
1923 gain	10	14	92	32	$4,384,594

During 1924, up to and including March 6, the value of the reported Federal government contracts is $6,811,236.

The trend of Federal government contracts is shown by comparing the totals of the past seven years with that of 1913:

1913	$39,405,000	1920	$35,281,531
1917	103,463,381	1921	26,602,391
1918	416,910,217	1922	43,555,406
1919	72,375,400	1923	47,490,000



CONTRACTS AWARDED BY U. S. GOVERNMENT—1922 AND 1923

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 155 to 170, are the following:

Office, Boston, Mass., Liability Assurance Co., to G. N. Harvey Co., $2,500,000.

Hotel, Albany, N. Y., Lussier Hotel Co., to H. L. Stephens Co., Binghamton, $2,500,000.

Clubhouse and apartment, Cleveland, O., Fraternal Order of Eagles to J. F. Sperry, St. Paul, Minn., $1,500,000.

Theatre, Coney Island, N. Y., Chanin Constr. Co., $1,250,000.

Business Briefs

Call Money easy with rates from 3½ to 4 per cent, March 17.

Time loans slow at 4½@4¾ for all periods.

Commercial paper ranged from 4¾@5 per cent for all names.

Foreign exchange. Sterling, $4.28½; week ago, $4.26¾; year ago, $4.69⅝. Franc, $0.0494; week ago, $0.0375; year ago, $0.0646. Lira, $0.045½; week ago, $0.0408¼; year ago, $0.0485½.

Drop in February Cement Output Compared With Preceding Month

The February production of portland cement for the entire country fell off 2 per cent from the month preceding, according to the Geological Survey. Shipments gained, however, to the extent of 723,000 bbl. during the month. Stocks on hand March 1, at mills throughout the United States, amounted to 16,811,000 bbl., a gain of 2,000,000 over the preceding month and 3,000,000, compared with a year ago.

Cement is following its normal seasonal trend so far as shipments and stocks are concerned; production, however, was on the increase a year ago this time, which situation was exactly the reverse of the present condition.

Judging from records of former years, statistics for March will show increased output and shipments, with a lowering of stocks on hand at the end of the month, compared with the amount available Feb. 29.

The following tabulation shows the cement situation with regard to production, shipments and stocks on hand for the first two months of this year and last:

	Production (Barrels)		Shipments (Barrels)		Stocks on Hand at End of Month (Barrels)	
	1923	1924	1923	1924	1923	1924
January	7,990,000	8,788,000	5,628,000	5,210,000	11,477,000	14,155,000
February	8,210,000	8,588,000	6,090,000	5,933,000	13,596,000	16,811,000

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 155 to 170, are the following:

Crematorium, Portland, Ore., for Portland Crematorium Ass'n., $1,300,000.

Clubhouse, Indianapolis, Ind., for Columbia Club, $1,000,000.

Bank and Office, Long Beach, Calif., for Security Trust & Savings Bank, $1,000,000.

February Bond Sales Heaviest in Thirty-two Years

The *Commercial and Financial Chronicle* reports the February public bond sale to be $90,499,323 compared with $92,052,504 in January and $79,688,459 in February a year ago. The total of separate issues dropped in number during the past month. The number of large sales helped to augment the total for the month. Philadelphia placed two issues totaling $12,000,000; Los Angeles issued bonds for $10,975,000; and the State of Minnesota sold an issue of $10,000,000. Other important issues are the following: Jersey City, N. J., placed $4,250,000; Chicago South Park District, Ill., $3,040,000; Corpus Christi, Tex., $2,000,000.

The February bond sales total makes it the heaviest for this month in a period of 32 years.

In the accompanying table, five sales were at par, thirty-six above par, two below par. The rates ranged from 4 to 6 per cent.

Wage Demands Retard Canadian Building

Indications are that the comprehensive scheme for building in eastern Canadian territory, to be started late in March, will be greatly curtailed if the executives of the bricklayers, plasterers and masons' unions, do not modify their demands. Recently, the executives notified the builders and general contractors of the territory that for the 1924 season, wages asked would be $1.12 per hour, an increase of 20c. per day.

Some of the members of the labor organizations have emphatically refused to agree to a modification of the demands. The builders have served an ultimatum that they will not agree to the wage increase. Conferences have been proposed as a means of effecting an adjustment of the situation. When asked if they intended to tender on the construction of the new Admiral Beatty Hotel in St. John, N. B., members of some of the biggest contracting firms in eastern Canada replied in the negative. They attributed their unwillingness to bid to the exorbitant demands of labor in all grades. Therefore it is likely that this hotel, planned as the biggest in the maritime provinces will be built by an outside concern. The United Hotels Company will add the hotel to their long chain of hostelries in the United States and Canada.

The province of Quebec will not be affected as the wages for 1924 in that province will continue on about the same plane as in 1923.

Market for Construction Machinery Developing in East

Reports received by the Bureau of Foreign and Domestic Commerce from the U. S. Consul at Hongkong, China, call attention to the fact that a more extensive market for American construction machinery is developing in the East.

Hongkong is at present enjoying a building boom, and because of this and the increasing costs of labor even the native contractors are beginning to show an interest in modern methods involving construction machinery.

At present there is only a limited amount of modern construction machinery in use in the Hongkong district, but it is probable that with the present building boom and the proposed important development schemes, a market will be opened for concrete mixers, pile drivers, excavators, and other similar machinery. Until recently the ample supply of cheap labor has retarded the introduction, on a large scale, of modern machinery; but with the increasing demands of labor, native contractors are slowly learning that modern machinery is considerably cheaper in the long run than cheap, inexperienced labor. It is therefore believed that this market for the next few years will be worthy of the attention and consideration of American construction machinery manufacturers and exporters, especially those specializing in concrete working equipment and pile drivers.

There are now approximately 20 con-

REPRESENTATIVE PUBLIC BOND SALES, FEBRUARY, 1924

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Massachusetts	Water Loan	$1,000,000	4	101.268	3.91	Jan. 1	1925—64	National City Co. of New York
	Subway Impt.	96,000	4			May 1	1925—74	
Michigan	Highway	3,000,000	4	100	4	Feb. 15	1944	Geo. B. Gibbons & Co., New York
			4½	104.4	4.31			
Minnesota	Rural Credit	10,000,000	4½	100	4.64	Feb. 15	1944	Guaranty Co. of New York and others
			4¼					
South Dakota	Rural Credit	3,000,000	..	100.001	5.04	Jan. 15	1934—44	Redmond & Co. of New York and others
County								
Boone, Ind.	Road	26,000	6	100	6	Jan. 19	1925—34	City Trust Co. of Indianapolis
Baltimore, Md.	Road and school	750,000	4½	101.864	4.34	Feb. 1	1937—44	Stein Bros. & Boyer and others
Cherokee, N. C.	Road	75,000	6	100	6	Feb. 11	.....	Walter, Moody & Heimerdinger of Cinn.
Cattaragus, N. Y.	Road	700,000	4½	100.10	4.24	Feb. 15	1929—42	Bankers Trust Co. of N. Y. and others
Clermont, O.	Road	50,000	5½	101.52	5.416	.....	.....	Seasongood & Mayer of Cincinnati
Edgecombe, N. C.	Bridge	100,000	5	101.42	4.90	.....	1929—64	Caldwell & Co., Nashville
Freeborn, Minn.	Ditch	42,000	4½	100.50	4.69	Feb. 1	1934	Minnesota Loan & Trust Co., Minn.
Fulton, O.	Highway	35,000	6	100.88	5.72	Sept. 1	1925—29	Detroit Trust Co., of Detroit
		13,000	6	106.87	3.88	Sept. 1	1925—27	
Herkimer, N. Y.	Roads	462,000	4½	102.35	4.30	Mar. 1	1927—54	A. M. Lampert & Co., of New York
Hamilton, N. Y.	Highway	75,000	5	107.09	4.40	Jan. 1	1934—48	Geo. B. Gibbons & Co. of New York
Huntington, Ind.	Road	22,800	5	100.75	4.83	July 15	1924—33	J. F. Wild & Co. of Indianapolis
Hardee, Fla.	Road	850,000	6	103.55	5.72	Jan. 1	1928—57	Breed, Elliott & Harrison and others
Jay, Ind.	Drainage	20,408	6	100.63	5.66	Dec. 8	1924—26	City Trust Co. of Indianapolis
Jerome, Ida.	Road and bridge	40,000	5½	102.30	5.27	Feb. 1	1934—43	Benwell, Phillips & Co. of Denver
Kossuth, Iowa	Road	175,000	5	100.26	4.94	Mar. 1	1929—30	Second Ward Securities Co. of Milwaukee
Lyon, Kan.	Road	180,000	4½	100	4½	Jan. 1	20 years	Stern Bros. of Kansas City
Miami, Ind.	Road	80,800	4½	100.01	4.49	Aug. 15	1924—42	Wabash Valley Trust Co.
Passaic, N. J.	Road and bridge	678,000	4½	100.136	4.48	Feb. 1	1925—45	R. W. Pressprich & Co. and others of N.Y.
Schoharie, N. Y.	Highway	250,000	4½	100.80	4.35	Feb. 1	1925—34	Sherwood & Merrifield of New York
Sumner, Tex.	Highway	150,000	5	101.30	4.92	.....	.....	The American Co. of Nashville
Taylor, Wis.	Road	100,000	5	100.75	4.85	April 1	1925—34	Mississippi Valley Trust Co of St. Louis
Warrick, Ind.	Road	44,000	5	101.50	4.80	Jan. 8	1925—34	City Trust Co. of Indianapolis
Township								
Madison, O.	Road	4,000	5½	100	5½	Jan. 1	1924—29	Exchange Bank of Madison
Municipalities								
Asheboro, N. C.	Water and sewer	$105,000	5	100	5	Feb. 1	1927—68	First Nat. Bk. of Randolph and others
Auburn, N. Y.	Pub. Impt.	181,811	4½	100.09	4.23	Feb. 1	1924—34	Barr Bros. & Co. of New York
Albany, Ore.	Sewer	67,589	5	100.278	4.99	Feb. 13	20 years	Ralph Schneelock Co. of Portland
Champaign, Ill.	Subway	150,000	4½	100.64	4.47	July 1	Yearly	Northern Trust Co. of Chicago
Chicago South Park District, Ill.	Park	3,040,000	4	95.938	4.52	Feb. 15	1925—44	Halsey, Stuart & Co. and others
Fort Worth, Tex.	Funding	1,250,000	5	103.17	4.79	Feb. 1	1929—64	Austin, Grant & Co. and others of N. Y.
Fairmont, W. Va.	Water	150,000	5	101.61	4.87	Jan. 1	Yearly	Weil, Roth & Irving Co. of Cincinnati
Greensboro, N. C.	Civic Impt.	1,400,000	5	100.38	4.97	Jan. 1	1924—64	A. B. Leach & Co. and others
Leesbury, Fla.	Paving	95,000	5½	99.10	5.69	Feb. 1	1925—34	Atlantic Nat. Bk of Jacksonville
Leland, Miss.	Sewer and paving	120,000	5½	100.06	5.49	Nov. 1	1929—43	Hanchett Bond Co. of Chicago
New Haven, Conn.	Impt.	845,000	4½	102.318	4.06	Mar. 1	1929—53	Eldridge & Co. of New York
Newton, Mass.	Sewer	100,000	4	101.172	3.88	Feb. 1	1925—54	Curtis & Sanger of New York
Omaha, Neb.	Impt.	1,000,000	5	100.689	4.73	Mar. 1	1929—39	Remick, Hodges & Co. and others of N. Y.
Riverhead, N. Y.	Highway	80,000	4½	101.11	4.385	Mar. 1	1925—44	Curtis & Sanger of New York
Worcester, Mass.	Sewer	400,000	4	100.141	3.98	Oct 1	1924—43	F. S. Moseley & Co. of Worcester

crete mixers in the colony, the majority of them being of English manufacture. These mixers are well constructed, but slightly higher in price than similar machines of American manufacture. Any mixer (regardless of quality) which can be sold at a very low price is the one which will usually be purchased by the native contractor. British concerns usually receive one mixer for demonstration on consignment, payment to be made on sale of the equipment.

The demand for foreign pile drivers is on the increase, as land values in the colony are rising and it is necessary to increase the height of buildings in order to secure satisfactory returns on in-

Demand for Excavators

Up to the present the majority of the piles have been of wood, and a locally made wooden piling frame, with the usual monkey or hammer, has been employed, being operated either by steam or hand winch. Recently, concrete piles have been used, being driven in a similar manner.

In some cases the undersoil in the district of Hongkong is very soft and intermixed with large granite bowlders which interfere with the operations of steam shovels. Only in the case of one or two large reclamation projects would it be possible to employ modern steam shovels. Local conditions are more suitable for the employment of excavators of the small, heavy, grab type, none of which are at present in use.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Mar. 6; the next, on Apr. 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	$4.20
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	5.15	5.00	4.05	5.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+53.2%	43%	47%	55.05%	36%	37.10@47.40%	45%	47-43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	56.00	61.00	57.20@60.20	61.50	69.00	60.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.72
Gravel, ¾ in., cu.yd.	2.00	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.40	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	40.00	54.75	55.00	42.75@44.00	+55.00	36.00	—28.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65@25.85	12.00	11.60	11.00	14.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.064	.075	.065	.....	11	.115
Hollow partition tile 4x12x12, per block	.1179	.091	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.95	—1.04	1.15	.94	—1.04	—1.12	+1.07	1.15	1.18
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	+.50@.55	.35@.50	50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 96.73). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

The current week marks the beginning of the spring building season for 1924. The usual upward trend in materials' prices, however, is absent from the present market. Steel, concreting materials, lime and the clay products show a tendency to remain at present levels for a time. Lumber and linseed oil however, have shown slight price weaknesses during the last week.

Demand for lumber has dropped slightly during the last ten days, particularly in pine and Douglas fir. Shipments are active, however, from the Douglas fir producing centers of the Northwest, to California and the Atlantic seaboard. Lumber inquiries denote a better condition of demand for April. Boards, timbers, railroad and special cuttings are inactive; the demand for flooring, finish and dimension lumber, however, is still good.

Pig-iron buying is mostly confined to small lots at present, with the price of No. 2 foundry at a minimum of $23.50 per gross ton, f.o.b. Birmingham. The volume of new inquiries for steel structurals does not measure up to expectations, although the price is still firm at $2.50 per 100 lb., f.o.b. Pittsburgh mill, for ordinary tonnages. A substantial demand for plates is evident, particularly from railroads and ship builders. Bar quotations center around $2.40 per 100 lb. f.o.b. mill. Quotations have been heard, on exceptional tonnages, reaching as low as $2.25 for plates, $2.30 for shapes and $2.35 per 100 lb. on steel bars. Bookings of malleable and commercial steel castings are on the increase and the American Locomotive Co. reports orders for ten new engines from the Grand Trunk Ry. and thirty locomotives for the Canadian National Railways.